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THEOBALD SMITH; INVESTIGATOR AND MAN[1]

By Professor SIMON HENRY GAGE

CORNELL UNIVERSITY

To understand even imperfectly any human being, it is necessary to know something of his heredity and his environment.

Theobald Smith's hereditary endowment came from skilled workers and teachers. Engrained therefore in his very being were the sterling qualities of industry and intellectual appreciation.

He was born in Albany and spent his childhood and early manhood in the state of New York preparing for his life-work. In 1884 this began in the Bureau of Animal Industry in Washington, and continued there until 1895. In 1895 he was called to Boston to aid in the State Board of Health and to join the staff of the Harvard Medical School, where he remained until 1915, when he removed to Princeton to assume the directorship of the Department of Animal Pathology of the Rockefeller Institute for Medical Research. In this position he remained as director and emeritus director to the end of his life in 1934.

Theobald Smith had his beginning and entire career of seventy-five years in one of the most stirring periods in human history, 1859–1934.

As the study of astronomy had taken the material universe out of the maze of superstition and made the earth, not the center of the universe, but only a minor part of it, so organic evolution had put living things

[1] Address at the Theobald Smith Memorial Session of the American Association for the Advancement of Science before the joint meeting of the Section on Medical Sciences (N) and the Central New York branch of the Society of American Bacteriologists, the president of the association, Dr. E. G. Conklin, presiding. The address was given in the room where ten years before at the dedication of the Rochester School of Medicine and Dentistry, Dr. Smith had lectured on "Immunity, Natural and Acquired." A large portrait of Dr. Smith at the age of 62 was hung on the wall in front of the audience.

in the realm of orderly development subject to definite laws.

Disease likewise was being taken from the regions of mystery in which it had been considered the arbitrary infliction of supernatural forces and was being proved to be the result of natural causes and subject also to laws which were slowly being discovered. Dr. Smith was destined to be one of the foremost leaders in that discovery.

Education, too, was feeling the pulsations of the inspiring period, and it became increasingly clear that study of the humanities alone was not sufficient preparation for the new era, but that there should be added the acquisitions that science and engineering were increasingly ready to give.

Theobald Smith heard the inspiring call and added to the thorough discipline that mathematics and the classics offered a thorough grounding in physics, chemistry and biology. To these he added what medicine, that great mother of science for countless generations, could give. In a word, he had prepared himself to play a part in his day and generation. This was in 1883.

It may be recalled that in this period the country was confronted not only with the deadly scourges of tuberculosis, malaria, diphtheria, typhoid and yellow fever for human beings, but that animal diseases were causing such appalling losses among the live stock that the food supply of the country was menaced and the government had established a Bureau of Animal Industry to meet the demands for help. It was Dr. Smith's good fortune to join the group that was to make the crusade and, as pathologist and bacteriologist, to act as leader in finding out the causes of the deadly plagues that were destroying the live stock.

It will be remembered, too, that in this period was proved absolutely untrue the long-held belief in spontaneous generation in all living forms, even the lowly bacteria demonstrated by Van Leeuwenhoek in 1675. And it was being shown with increasing certainty that the microscopic forms of life were the active agents for many types of disease and death. Lister was showing month by month that the sepsis that had haunted the hospitals might be eliminated by the exclusion of the deadly microbes from wounded surfaces, thus making surgery safe for all the world.

Dr. Smith appreciated deeply the significance of the microscopic forms of life for medicine, promptly became master of the methods of bacteriology already known, and soon added other methods and refinements of his own, which gave increasing certainty to the findings.

Of course, in dealing with a life so rich in accomplishments, only a few high points can be touched in a short appreciation like this.

The first great field of battle Theobald Smith entered was that on which was made the fight against the diseases that were mowing down the pigs by the thousands and threatening that important source of the food supply. He found the pigs such a favorable culture medium for multitudes of bacteria and parasites that it had up to that time proved impossible to separate the deadly ones from those less harmful. Here then was a field for the full exercise of his penetrating mind and his persistent quest. He brought something like order out of the chaos by showing that not one but two special diseases were attacking the pigs, swine plague and hog cholera, the first affecting the respiratory and the second the digestive system. Further, there were made the beginnings by which swine diseases were to be controlled; it may be added in passing that the efforts are still being made.

Perhaps the discovery of greatest significance in these investigations by Dr. Smith was that immunity might be produced by the help of the very agents of death themselves, by using the products of their life activity. It will be recalled that immunity itself had long been sought by the use of the actual virus transferred from one human being to another, as for smallpox, but often with fatal effects, until Jenner in 1776 proved conclusively that the harmless cowpox gave the immunity; and Pasteur and others showed in 1880–82 that the aging of some and the moderate heating of other microbic cultures might, while rendering the bacteria comparatively harmless, also induce immunity against the fatal effects of active cultures of the same germ. Dr. Smith's discovery was the possibility of gaining the immunity, not by the virus itself, but by the metabolic products of the living organisms composing the virus. This finding was published on February 22, 1886, and the three short paragraphs of the conclusion state the case so clearly that they deserve to be quoted verbatim:

(1) Immunity is the result of the exposure of the bioplasm of the animal body to the chemical products of the growth of the specific microbes which constitute the virus of the contagious fevers.

(2) These particular chemical products are produced by the growth of the microbes in suitable culture liquids in the laboratory as well as in the liquids and tissues of the body.

(3) Immunity may be produced by introducing into the animal body such chemical products that have been produced in the laboratory.

Dr. Smith continued the study of immunity all his life, and gives the subject a prominent place in his last great work published in 1934. That artificial immunization is not a panacea for all microbic diseases is in accord with the complexity of nature so fully comprehended by Dr. Smith, and implied in his re-

peated assertions that man must work with nature and recognize as best he can the varying constitutions of different forms and their reaction to morbific agencies.

While the work on swine diseases was in full progress, Dr. Smith wrote in 1884, "We shall soon attack that still unsolved mystery of Texas fever." And it was a mystery that had baffled the most expert pathologists of Europe and America for a generation. It was both deadly and mysterious. Apparently healthy cattle from the South when brought to the North left a trail of death for northern cattle, and when northern cattle were taken South they were almost certain to become infected and die, although the southern cattle among which they were herded seemed entirely well.

As Jenner had listened to the dairy maid when she told him of the protection against smallpox that the cowpox would give, so Dr. Smith acted on the hint of the southern cattlemen that in some way the cattle ticks, almost universally present on southern cattle, were the agents that carried the disease from animal to animal. He insisted, however, that for the final elucidation of the mystery there must be a herd of southern cattle near the laboratory and under absolute control. With these tick-infested animals under laboratory control, it was proved conclusively by experiments continuing over several years that with the ticks the cattle were a menace to northern cattle, but without them they were harmless. In a word, "No ticks, no Texas fever." Let me quote Dr. Smith's own statement of the final solution of the real problem:

> You see that after it had been shown that the disease failed without the ticks, everything was still to be done. Nothing was known of the nature of the disease, whether it was a liver or an intestinal and septicaemic disease. However, the very first case gave me the clue, and then the existence of blood parasites naturally suggested some ectoparasite to draw them out. But how did the animals become infected? Did they eat the ticks? Did the young ticks produce a toxin? Were the intraglobular bodies degenerated red cells? To say that a protozoan parasite passes from old to young ticks through the egg and then into the mouth parts required some proof before it would be accepted at that time. The entire work fell on me as every case had to be blood-examined and the corpuscles counted. The final experiment of breeding the young ticks from the eggs and putting them on the cattle I did myself. It required four years of slavery at the microscope, at autopsy, at watching tick broods, at the long labor of preparing the report.

As in nature Texas fever never appears without ticks, it follows logically that to avoid the disease the ticks must be eliminated from the cattle. That relatively simple process is saving the cattle industry of the South, and making it safe for northern cattle to be taken South, and for tickless southern cattle to be brought to the North.

While the economic significance of the Texas fever work of Dr. Smith can hardly be over-valued, it has even greater significance for human medicine and for biology. It showed unmistakably that, in mammals, insects (arthropods) may carry deadly disease germs from individual to individual; and still further, that in some cases the germs may be carried over from generation to generation of the insects through the eggs. These demonstrations (the first for insect-borne diseases) opened the road to others to find out how insects transmit malarial parasites from person to person, also the germs of sleeping sickness, yellow fever, typhus fever, spotted fever and many other diseases; the list is increasing year by year. Subsequent investigations have also shown that the Texas fever tick is not the only animal that transmits germs through the eggs to the next generation; this method has been found in several other insects, and even in forms as high in the zoological scale as some birds.[2]

Since I deeply appreciate that a speaker must always keep in mind the danger of the bias that personal friendship may induce, I shall quote the estimate of one whom all men revere on this work. At the banquet on the opening of the Theobald Smith House at Princeton, Dr. William H. Welch said, after he had spoken of the swine diseases:

> Then came quickly the study of Texas cattle fever, that work of the time in the study of infectious diseases, and simply immortal work, one of the most brilliant pieces of one of the most important contributions made in the history of medical research, beginning first with a thorough study of the insect conveying the disease, one of the dis-

[2] To readers not familiar with the Texas fever malady, it may be stated that it is characterized by high temperature, often to 106 or 107 F., rapid pulse and breathing on the least exertion and frequently haemoglobininuria. It is essentially a blood disease with destruction of the red blood corpuscles. The number may fall from the normal five to six million per cubic millimeter to less than two million; sometimes to even one million. Toward the end, the loss may be one million in twenty-four hours. This loss of the blood corpuscles can not be accounted for by the relatively small amount of blood drawn by the ticks attached to the cattle. It is not a bacterial disease, but one due to a protozoan parasite which destroys the red corpuscles. The wonder increases as it appears that the parasite is introduced into the cattle by the bites of the young ticks that have carried the parasite from its mother through the egg from which it was hatched, that is, from one generation to the next through the egg. This is the first instance conclusively demonstrated where insects (Arthropods) carry disease germs from animal to animal. Pasteur showed in the 60's that disease may be carried in the eggs to infect the new generation of silkworms, but this demonstration of Dr. Smith showed that insects may transmit disease to an entirely different species, a proposition so novel that it was designated at the time in America as "a romance in pathology" and in some famous foreign laboratories as the "American fairy-story and humbug."

eases of the group to which malaria and yellow fever belong. The significance of Dr. Smith's work on Texas cattle fever is hardly yet realized. . . . This discovery of Theobald Smith's, which I regard as one of the greatest ever made in this country, and as being the first in this whole group of insect-borne diseases, including the mosquito-carried malaria and yellow fever, had a very real relationship to human disease of this nature.

Let us now consider another investigation by Dr. Smith which poured new light upon that great scourge affecting both animals and men, namely, tuberculosis. In 1886 he presented a paper before the American Association for the Advancement of Science—"On the Variability of Pathogenic Organisms as Illustrated by the Bacterium of Swine Plague." From time to time afterward, he returned to this variability in discussing diseases and their manifestations, the inevitable necessity for variability with changing environment and the stress upon the organism when adapting itself to a parasitic life. The first and fundamental postulate is that parasitism is not an original condition in any form, but has come about by adaptation in the struggle for existence, and from the general law of the survival of the fittest. Only those which can adapt themselves to their changing environment will finally survive. As environments are so varied and changing, it follows inevitably that adaptation requires compensating changes in the parasitic organism.

With these broad principles in mind, Dr. Smith, in his investigations on tuberculosis from 1894–1898, was prepared to find modifications in the tubercle bacilli of different animals, contrary to the prevailing belief ever since the discovery of the tubercle bacillus as the etiological factor in tuberculosis by Koch in 1882, that in all mammalian tuberculosis, at least, there was but one form of bacillus, and that it might pass freely from one species to another. With his usual skill and persistence Dr. Smith commenced in 1894 to determine the facts. In 1896 he stated his preliminary conclusions before the Association of American Physicians. In 1898, in the *Journal of Experimental Medicine,* he published "A Comparative Study of Bovine Tubercle Bacilli, and of Human Bacilli from Sputum." In the sixty pages of this great paper, he presented the evidence backed by experiments as rigid as those used in the Texas fever work and decided that there were two types, one for the human being, the ***human type*** and the other for the ox, the ***bovine type***. The two types were recognizable, first, by their form; second, by their growth and reaction in culture media; third, in the vital test of interchange between humans and bovines; and fourth, by the change in virulence in the two forms.

The wholesale transmissibility from bovine to human and the reverse did not occur. In spite of the possibility of the transmission by way of the milk and meat of the bovine so universally used as food, the bovine tubercle bacillus was very rarely found in human beings, and then mostly in the intestinal tract of children who had eaten the raw milk of tuberculous cattle. The relief that this brought can hardly be overestimated. It was a terrible outlook when it was thought that every piece of beef and every cup of milk might carry the dreaded germs of tuberculosis to adults and children.

It seems too bad to omit so much of Dr. Smith's important work, not to follow that work to the end of his life; but time will allow only a brief characterization of him as a human being. After all, we like to have some idea of an individual's human qualities as well as his purely intellectual achievements, so in the remaining time I shall speak of him as a man.

If in the eyes of his colleagues and fellow workers Dr. Smith seemed a model investigator, to those who knew him intimately he seemed also a model man. He was considerate, absolutely honest in mind and heart, a most delightful companion, whether in outings in the mountains of New York and New Hampshire or at the national scientific meetings. He was always ready to take his full share of the necessary labor and by his intellectual vivacity to add brilliancy as well as happiness to the occasion. Then, in addition, we felt instinctively that he was one of the great of the earth.

How he was looked upon by those working with him may perhaps be best expressed in their own words. In 1895, when Dr. Smith was about to leave Washington for Boston, Dr. V. A. Moore, who had been Dr. Smith's assistant and had been recommended by Dr. Smith to become his successor as director of the pathological laboratory in the Bureau of Animal Industry, wrote:

> Whether I can do work enough to keep up the reputation of this division is a difficult problem for me to face. Dr. Smith is the most wonderful man I ever met; and the amount of work he can accomplish is phenomenal.

The following is the testimony of the beloved emeritus president of Harvard University, who had with Dr. Walcott induced Dr. Smith to go to Boston to develop a laboratory for the production of safe vaccine for protection against smallpox, and for the preparation of antitoxin to safeguard against diphtheria and tetanus, and to build up a department of comparative pathology in the Harvard Medical School. President Eliot said:

> Dr. Theobald Smith has stood for me ever since I have known him as a completely satisfactory type of the modest scholar; simple, modest, candid, diligent, accurate, inventive, imaginative and conscientious, loving truth, seek-

ing truth for its own sake and also for a remoter object, the welfare of mankind, the good of his fellow men.

At this same banquet when President Eliot spoke in farewell to Dr. Smith as he was leaving Boston for Princeton to create the Department of Animal Pathology in the Rockefeller Institute for Medical Research, Dr. Simon Flexner said:

Indeed, it was Dr. Smith's vision of such an independent department of animal pathology, itself conceived on broad lines, that made it attractive first to his colleagues in the directorate of the Rockefeller Institute, and then to the founder, John D. Rockefeller, Jr., who was to give it his financial support. This support, you may be interested to know, came promptly as soon as it was known that Dr. Smith would undertake the direction of the new work himself. I need not, in this company, who hold Dr. Smith's services at so high a value, say that he of all men, not only in this country, but in the world, is the best fitted to fill that office.

Here is another tribute which came after his service as Harvard exchange professor at Berlin in 1911–12. The director of the Bureau for Exchange Professorships wrote to President Lowell concerning the impression Dr. Smith had made: "The whole learned world looks upon Dr. Smith as the best type of the American scholar and the American gentleman."

From this list of tributes I can not leave out that of Dr. Conklin, chairman of the Princeton Chapter of the Sigma Xi: "Although he was one of the most illustrious members of this society, he was so modest, so simple in manner, so sincere in word and deed and so kind a friend, that our admiration for his achievements was ever mingled with affection for the man."

But after all, it is from his letters and addresses that we can gain the truest glimpse of Theobald Smith's real character. In an address upon research he thus depicts what seems to him the right spirit:

It is needless to say that the position of the research worker of the immediate future will not be an easy one. . . . The gap of years and even generations may yawn between the problem in hand and its actual solution. It may be wholly impregnable from the point of attack. It may be solved by some obscure genius with slight facilities who happens to hit the combination which unlocks the secret. . . . The researcher does not march with the procession, but he must do lonely, outpost duty.

Again, in the address upon "Scholarship in Medicine":

The scholar's rewards will always be small. The distinguished men who have gone before have not been in the habit of thinking of themselves, and this habit should not be encouraged. In the future ideal state of society, when we shall be doing our tasks instinctively, when we shall say with Luther, "I can do naught else, God help me," we shall not be thinking much of ourselves.

Take also this sentiment expressed near the close of his career:

We who have dealt with the finitely small living things have, perhaps, as much a sense of the highly complex, unfathomable, the eternally elusive in the universe as do those who look for the outer boundaries of space. Each group contributes a different story of the same final significance.

How truly do these quotations sum up the noble character and lofty spirit of Theobald Smith!

The great Newton said near the end of his life:

However I may appear to others, to myself I seem to have been only like a little boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, while the great ocean of truth lay all undiscovered before me.

So Theobald Smith near the close of his life wrote:

As I walk home from the laboratory, I think how little I really know about the things I am working upon.

Yet these two brave spirits did not cease from labor as the shadows lengthened, but lived what Longfellow said in his "Morituri Salutamus":

What then? Shall we sit idly down and say
The night hath come; it is no longer day?
The night hath not yet come; we are not quite
Cut off from labor by the failing light;
Something remains for us to do or dare. . . .
For age is opportunity no less
Than youth itself, though in another dress,
And as the evening twilight fades away
The sky is filled with stars, invisible by day.

Note: The career of Theobald Smith may be summarized thus: He was born in Albany, N. Y., on July 31, 1859, and died in the New York Hospital on December 10, 1934. His early education and preparation for college were gained in the schools of Albany. In 1877 he entered Cornell University and graduated with the degree of Ph.B. in 1881. In 1883 he received the medical degree (M.D.) from the Albany Medical College. During a part of the time between 1882 to 1884, he did graduate work in biology at the Johns Hopkins University, at Toronto and at Cornell Universities. From 1884 to 1895 he was director of the pathological laboratory of the Bureau of Animal Industry in the United States Department of Agriculture at Washington, D. C. On May 17, 1888, he was married to Lilian Hillyer Egleston. Three children were born in this family—Dorothea, Lilian and Philip. In 1886 he established the department of bacteriology in the Columbian (now George Washington) Medical School, and taught the subject until 1895. So far as can be found this was the first department of bacteriology in a medical school in America. In 1888 he gave some lectures on bacteriology in its relation to hygiene in Cornell University and thus established bac-

teriology in that institution. From 1895 to 1915 he was director of the pathological laboratory of the State Board of Health of Massachusetts and developed means for the production of vaccine for protection against smallpox and for the production of antitoxin for diphtheria and tetanus. From 1896 to 1915 he also served as professor of comparative pathology in the Harvard Medical School. In 1915, he accepted the position of director of the department of animal pathology of the Rockefeller Institute for Medical Research at Princeton, N. J. Here he served until 1929, when he became emeritus director. In 1911–12 he was Harvard University exchange professor at Berlin. In 1926 he was president of the International Society against Tuberculosis and of the Congress of American Physicians and Surgeons. He was a member of many of the great societies and associations for the betterment of mankind and the advancement of science and medicine. In 1886 he became a member and in 1887 a fellow of the American Association for the Advancement of Science. He was a member of the great college societies of Phi Beta Kappa, Sigma Xi and Phi Kappa Phi. He received twelve honorary degrees from leading universities and eleven medals, among which was the Copley gold medal of the Royal Society, generally regarded as the highest scientific award in the world. His additions to knowledge are contained in the 280 publications noted in the "Theobald Smith Bibliography" so painstakingly and accurately compiled by Dr. Earl B. McKinley and Ellen Grey Acree, of George Washington University Medical School.

S. H. G.

PRESENTATION OF THE 250 THOUSANDTH BAUSCH AND LOMB MICROSCOPE TO PROFESSOR FREDERICK G. NOVY

ADDRESS OF WELCOME BY THE PRESIDENT OF THE BAUSCH AND LOMB OPTICAL COMPANY

ROCHESTER is particularly proud and fortunate to have this meeting of the American Association for the Advancement of Science. We feel that it is a particularly fitting thing that you should meet here because of the close association between the type of industry and manufacture that is carried on in our city and the aims and ambitions of the association. We think also that it is particularly fitting, because here there is a close association of industrial effort and education, all in the interest of furthering the same types of objectives which prompt the American Association.

From the educational standpoint we have in Rochester, of course, our University of Rochester, with which you are all reasonably familiar. This is an institution without ambitions of great size and magnitude, but an institution that has for its objective a very high-grade, perfected job of education. Then we have here the Mechanics Institute, which is, we believe, an outstanding educational endeavor. Mechanics Institute was founded by Captain Henry Lomb, who was one of the co-founders of the Bausch and Lomb Optical Company. In the Mechanics Institute there is a program of education of a vocational nature which we believe is outstanding. I need not tell you anything about the public school system of Rochester. We have here also an outstanding project in the sphere of education.

I won't begin to mention the many industrial establishments which are located in our city but which are intimately interwoven with the scientific endeavor of the country. We are here making contributions to science, just as in turn science is making contributions to our own industrial efforts.

We are very, very proud to have this ninety-eighth meeting of the American Association, and we of the Bausch and Lomb Company are particularly pleased because there is a certain amount of coexistence in your organization and ours. Our company is to-day eighty-three years old and an institution which has been conducted, I am glad to say, very effectively, dependent in many respects on the assistance and help of people like yourselves in this country, interested, as you are, with us in this scientific endeavor, and at the same time we are trying to make our contributions to assist you in the fine work which you are doing.

The Bausch and Lomb Optical Company is also very pleased to have you here as our guests to-day. It was a problem of considerable magnitude to know just how many of you were going to be here, but I am glad to say that as I stand here it looks as though we have a capacity house. We are glad to have you as our guests, and we hope as the years go on you will be so favorably impressed by what we have to offer in Rochester that in a not too far distant time you will want to come back and visit us. I am now going to turn this meeting over to Dr. Conklin, president of the association, who is going to introduce the other speakers. Thank you very much.

M. H. EISENHART

RESPONSE BY THE PRESIDENT OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

President Eisenhart, Mr. Bausch, Professor Novy, Distinguished Guests and Friends and Citizens of Rochester:

PRESIDENT EISENHART said that the citizens of

Rochester were happy and fortunate in having the American Association here as their guests this week. I am sure that every member of the association who is here would say that we also are both happy and fortunate—indeed so fortunate that I should not be surprised if your invitation to return might be accepted at a date not so far distant as that when we met here last. It was forty-four years ago that the American Association for the Advancement of Science met in Rochester, brought here very largely through the activities and solicitations of Professor Fairchild, who is still living, but, unfortunately, unable to be with us, and since that time, forty-four years ago, Rochester has contributed a very great deal to the fundamental—I might say revolutionary—development of science during this nearly half a century since we were here. The developments of science in this half century are certainly greater than in any other half century in the history of the world. To these developments the various institutions of this city have contributed—not merely the university and its research departments, but the commercial firms and their research departments—for, after all, excellent research has been done in these concerns which are turning out scientific instruments—research made in many instances at the suggestion of, and with the cooperation of the scientists who are using these instruments. In particular, I know of one such thing that has been turned out by the Bausch and Lomb Optical Company. One of my colleagues, Professor Harvey, with the aid of Dr. Alfred Loomis, devised the centrifuge microscope—one in which you can see the whirling object as it is going around at a terrific pace and yet can keep it in view all the time with the microscope. That has been put out by the Bausch and Lomb Company, and many other inventions of the greatest value in scientific research have been taken up and put through, even at great expense where you could not expect returns in a commercial way, so that I feel that the spirit of science does, to a very great extent, prevail here in this center—the altruistic spirit of wishing to see the progress of knowledge, whether it means profits or not. I doubt if the motto is anywhere to be found in Rochester which they say sometimes prevails in business—"No profits, nothing doing."

And now it is my pleasure and privilege to say a few words with respect to the particular event which has brought us together on this occasion. Some time ago the Bausch and Lomb Company approached the officers of the American Association for the Advancement of Science with the proposal that they would like to honor some very distinguished scientist, who used the microscope in his research, with the presentation of the quarter millionth microscope of their manufacture—the 250,000th microscope that has been turned out. Just think what that means! Of course, many other microscopes have been turned out in this country and other countries that have been used here in the schools and in the research institutes, extending the vision of man in the direction of the infinitely small as telescopes have extended vision in the direction of the infinitely large. We have been hearing an enormous amount through the newspapers of the 200-inch telescope. We have not heard so much about those marvelous microscopes, many of which are being made right here in this city.

When this appeal came to the American Association a committee was appointed by the council of the association to consider the matter and to make a report, and the question was asked of many persons who use the microscope as one of their principal instruments in research what living American has done very outstanding work for the welfare of mankind by the use of the microscope as a tool of research, and the result of this was that the person was selected who is here to-day to be honored with this gift.

I need not say anything more with regard to Professor Novy than is known to many of you perhaps even better than to me, because his work has been in the Medical School of the University of Michigan, and many medical men are here before me to-day. But Professor Novy has done notable work in his study of anaerobic bacteria, in his study of Trypanosomes and in his study, particularly, of the respiratory processes of bacteria. He is known throughout the world for this notable work, and now I have the great pleasure, not of presenting Professor Novy, because that falls to a more properly selected person, but I have the great pleasure of calling upon Mr. Edward Bausch to make this presentation. I won't undertake to introduce to you your distinguished fellow townsman. I will say that the American Association for the Advancement of Science is proud of the fact that for fifty-nine years he has been a member and fellow of the association, and for sixty years, I believe, he has been associated with the Bausch and Lomb Optical Company, chiefly as its president and director.

He showed me yesterday in the factory, which I visited and in which I was so deeply interested in what I saw (I had no conception that the concern was so big as it is and doing such a great variety of work as it is doing), the little microscope which he himself made with his own hands when he was fourteen years old. I wish I had it here to show you alongside of this greater microscope which is to be seen here to-day.

I have great pleasure in calling on Mr. Edward Bausch for the remaining period of this program.

Edwin G. Conklin

Princeton University

PRESENTATION OF THE MICROSCOPE

Dr. Conklin, Dr. Novy, Friends, Ladies and Gentlemen:

MY job is a comparatively small one, but there are some thoughts going through my mind of a rather reminiscent nature. I want to say a few words on my long connection with the association, being probably one of its oldest members. The first meeting of the association that I attended was in Nashville in 1877. The motive for my attendance at this meeting and those for many years to come was to become better acquainted with the people who were then outstanding in the field of science and to discover their needs and desires first hand so that we would be in a better position to serve and cooperate with them in the development of microscopes and other optical equipment which were so essential to their achievements.

And I am very happy to say this: In these contacts, not only at the association meetings, but also through the microscopical societies, which at that time sponsored a great deal of microscopical research, I met the outstanding members of the day, from the Atlantic Coast as far as St. Louis and Chicago, and I want to express now my deep appreciation, and that of my associates, for the help which we received, encouragement which we had, and suggestions which were made, all of which enabled us to do better work, build better and newer things and build to higher standards. The association was of the friendliest kind and most helpful. It was not only my traveling about that enabled me to meet these scientists, but many of them made it a point when passing through Rochester to visit us. Many of the outstanding men came to Rochester, spent a day visiting our then small plant, and it was my privilege sometimes to house them for a night or perhaps longer in our modest home. The encouragement then received and the contacts made at that time provided the foundation of what we are doing to-day.

Of course, in addition to this there was intense work and many discouragements, but all the while constant encouragement and cooperation enabled us to carry on. I am glad to say, further, that there has been a continuation of that same spirit to help along in the work being done by this company to aid the scientists. There are many of those old friends that I could name, but time will not permit it. However, there is one that I see looking at me, although I haven't had a chance to greet him—my old friend, Simon Gage. There are many of those, and I want to express here for myself and for our company that deep feeling of gratitude which we have, because, after all, while we originate and while we are doing our research (we are endeavoring to be ahead of the requirements all the time), nevertheless, many of the suggestions come from the outside, from you people. Many who are not here have enabled us to progress because of the encouragement which we have had from such sources. As an example, this particular microscope that I am to present to Dr. Novy was designed at the suggestion of Dr. Lester Sharp and Dr. L. F. Randolph, of Cornell University.

I haven't much more to say. It is a pleasure to have you here after such a long time—'92, I believe, is the last time we had you here. Rochester has grown in that time. There are representatives at our tables from concerns who are also identified outstandingly with progress made in various directions, and they, as well as we, will welcome your coming here again just as early as you can arrange to come.

Now, Dr. Novy, it becomes my great pleasure to present you with the 250,000th microscope which we have made. I remember well when we reached the 5,000 mark, the 10,000 mark, the 25,000 and the 50,000. Those were all big events in our career. It gives me great pleasure, Dr. Novy, to turn this microscope over to you. You have been a man of great achievement; you have accomplished much with very simple apparatus. I present you with our latest product, and I trust it may lead you to still further discoveries and be helpful to further improve the health and happiness of mankind.

EDWARD BAUSCH

SOME RESULTS OF MICROSCOPICAL RESEARCH WHICH HAVE BEEN SIGNIFICANT FOR HUMAN WELFARE

Dr. Conklin, Mr. Bausch, Mr. Eisenhart, Ladies and Gentlemen:

IT is needless for me to say that I have a very deep sense of appreciation of the honor of having been selected by the association for this award; and of my indebtedness to Mr. Bausch for his very kind expressions and for the very splendid microscope which we have here before us. I do hope to make use of it in such time as there may be left. You know, these oculars are made so that they can be adjusted to your eyes, but my eyes are still pretty fair and a little turn of a screw or so does the work.

I am rather in a difficult position as to what one should say here in regard to the achievements, that is, the practical results that have come to mankind from the use of the microscope. I presume that it is somewhat trite to say that without the microscope mankind to-day would be in the dark ages—that period which was defined once upon a time as being "Egyptian darkness." Just imagine, if you will, what would be the position or condition of mankind in so far as science is concerned if it were not for this instrument.

which has been perfected and developed from the very simple outfits of Galileo and Leeuwenhoek to this magnificent instrument here beside me. Without the microscope it is safe to say that we would have absolutely no knowledge of the cell structure of animals and plants; we would have no knowledge of fertilization and cell division; we would have no knowledge of fermentation or infectious diseases. There would be a lack of knowledge of cytology, of embryology, bacteriology and of protozoology; in short, the whole subject of microbiology would be non-existent—and I dare say, Mr. Bausch, that you would not have a very large audience here to-day if those who made use of the microscope or optical instruments in some form or another were thus excluded.

It took centuries, as a matter of fact, we will say two and a half centuries and more, before the microscope was actually brought into use for the benefit of mankind. It had been used in a general way to uncover this and that type of organism that was present in nature, but the great mysteries of fermentation and infectious diseases could not be touched until the right man and the right age and period arrived. That period in a way began to show itself on the horizon a hundred years ago when Schwann came out with his cellular theory, when the cause of scabies was rediscovered, when this and that organism of the larger size was recognized, but bacteria and disease were as yet not touched upon.

It was practically eighty years ago when the first step in the unveiling of the mystery of fermentation came with the entrance of Pasteur into that field. It is apparently a strange phenomenon not so much that a chemist should enter the field of fermentation, because that is largely chemical, but that a chemist should make use of the microscope in trying to solve this age-long mystery, for the chemist had never dreamed of using a microscope to aid him in his work. Pasteur, however, had the vision, which came to him from his previous studies of polarized light, that substances which rotated light were produced by living things, and since in fermentation there were products that rotated light it was but natural to look for a living cause. Therein we find the explanation of why a chemist made use of the microscope at that time; and, he was promptly rewarded by the detection of minute organisms. Others had seen bacteria, but they never connected them with any process in nature. It was reserved, therefore, for Pasteur to point out that these things which he collectively called yeasts, because he was not a botanist or a zoologist, were the causes of fermentation. But, as a chemist, he went further; he proceeded to cultivate these organisms, and he went still further inoculating batches of sterile material with his seedings and thus reproducing the phenomenon. He thus was able to establish an iron-clad demonstration of the relation of these organisms to this particular change. The same steps which he used in the study of fermentation eventually led to the uncovering of that mysterious phenomenon which had been known to man from the beginning of time, the diseases of man and animals. Twenty years passed before the first real disease was studied from the modern standpoint. But I might say in passing that the first fruit of Pasteur's work on fermentation was the application of the idea that ferment organisms caused similar changes in wounds; that they were responsible for suppuration in surgical operations, in accidents and the like. Pasteur's work stimulated Joseph Lister to apply means to destroy those organisms that might enter wounds, with the result that antiseptic surgery came into being, even before a single disease germ had been actually proven to be the cause of disease. As year followed year, the original crude methods of Lister gradually changed and evolved into the aseptic surgery of to-day. Every one, I am sure, must realize that without this modern method it would be absolutely impossible or at least it would be most unsafe to make the surgical operations which at present are everyday occurrences in every hospital in the world. Organisms in the past could destroy life if introduced into wounds or by incisions and operations. Then man did not know anything about the invisible enemy we had in the form of these organisms. But shortly after Lister came the real advance.

In 1876—a matter of sixty years ago—an obscure physician in an east Prussian small town, Robert Koch, with the use of a microscope of simple construction studied anthrax. Others had studied anthrax and they had seen the rod which Koch had seen, but they could not draw any valid conclusion as to its relation to the disease. But Koch, who, consciously or unconsciously, was actuated by the steps of Pasteur, proceeded to study it under the microscope. He was able to follow the growth, the multiplication, the formation of spores, the germination of spores, and so on. And then he applied those two cardinal subsidiary principles, that is to say, cultivation in the test-tube or in a container of some kind, and inoculation of animals, and when that trio of evidence was produced, then for the first time was unveiled the cause of this disease, primarily one of animals and incidentally of man.

That marked the beginning of an era. That was the beginning, we might say, of modern bacteriology. During the next two decades, utilizing the methods that were developed in the laboratories of Koch and of Pasteur, one disease after another was shorn of its secrecy. In rapid succession the microscope revealed this germ and that germ down the line. In that period

of say two decades, which may be properly spoken of as the "heroic age in bacteriology," the causes of some twoscore diseases were revealed, and that search has been carried on ever since with the result of a continuous increase in our knowledge through the help of the microscope.

I might add also in this connection that when Koch was doing this work in '76 and '78 the Bausch and Lomb Company brought out its first microscope, and is thus coexistent with the era of bacteriology. A couple of years later, with the introduction of the oil immersion objective and the Abbe condenser, the microscope became fully equipped for the work that was ahead. I have indicated briefly that a very large number of organisms have been found to be the cause of disease. The microscope perhaps can be credited with something else. It is not enough to see a germ in the disease process. You do not know much about it, however, until it has been cultivated and its effect tested upon the animal. Incidental to this study came the discovery of how the organisms enter and how they leave the body, and out of this came some of the great practical benefits to man. By way of example we may first mention typhoid fever, which formerly was common, claiming in every large city thousands of subjects each year. In the past year there have been only about 1,400 deaths from typhoid fever throughout the length and breadth of the land. Formerly, Chicago or Pittsburgh or Philadelphia had almost as many cases in a year as the whole United States has to-day. But since that time the way in which infection occurred became recognized and hence means could be taken to prevent the disease.

Not so many years ago—I remember it and I am sure Mr. Bausch remembers it also—we had cholera in this country. Its last appearance was in the 70's. Previous to that time cholera made its epidemic appearance from one end of the world to the other. Man was absolutely powerless to stop it, or seemed to be powerless. But, when Koch discovered the germ of cholera, studied it in detail with the help of the microscope and found the disease to be primarily water-borne, it became a rather simple matter to stop the further invasion of that organism. Its home is India and it followed the trade routes. Since then, in spite of a vastly greater commerce, cholera no longer travels from country to country as it once did. Here again the microscope has been responsible for the success in overcoming that scourge.

We might illustrate that by another example: In '82 Koch discovered the tubercle bacillus. One of the most deadly diseases of mankind was tuberculosis. It still is, but with the knowledge that has been acquired came the successive steps which led to the improvement of mankind, and while it is not likely that tuberculosis is going to be wiped out in any short time, there certainly has been a phenomenal decrease in incidence and mortality. The chances of recovery are vastly better to-day than thirty or forty years ago. I might go down the line in this way, showing how other disease organisms have been discovered and isolated and what precautions have been taken to prevent their spread, thus ensuring an effective control.

But there is one thing that I want to especially emphasize, and that is that the microscope aided directly in the discovery of what we call "carriers." I won't speak of the human carrier or the animal carrier, but of the insect carriers. We listened this morning to a beautiful address by Dr. Simon Gage on the life of Theobald Smith, in which he brought out the fact that Smith was the first to show that the carrier of Texas fever was an insect (a tick may not be, strictly speaking, zoologically, an insect, but the term answers the purpose. I fear that if we were to use the scientific name, some people would not know what we were talking about, so we will call the tick an insect). This was the first demonstration that an insect or tick was responsible for a disease. Dr. Gage remarked that at the time of the discovery it was commonly spoken of as a romance. I could supplement that by saying that in Europe it was looked upon as a case of American humbug. That was the first discovery that an insect could transmit disease, and yet in a few years after Smith's fundamental work came the demonstration that the mosquito was responsible for the spread of malaria. Ronald Ross, working in India, and later Grassi in Italy and scores of others, followed the road thus opened and solved the mystery of malaria. Here was an insect which fed upon the blood of a sick individual, the causative protozoan multiplied in the body of the insect, underwent development, passed into the salivary glands of the mosquito and then was injected into a new subject. All those steps the microscope had to unveil. Without it nothing could have been done.

To-day, in Italy, the Campagna is being made habitable for man, whereas for two thousand years it had been a proscribed place, the people not knowing exactly why death lurked in those regions. It is possible to control the scourge of malaria in many places when conditions in general are fair.

I might add that in the case of yellow fever we have again a mosquito carrier. We may not see the germ with the microscope, but we know that a particular mosquito is responsible for the spread of that disease. The result of this knowledge is that to-day yellow fever is practically non-existent. It does not cause the epidemics that it did in former years. There were times in the history of our country when yellow

fever came as far north as Philadelphia, St. Louis and even up to Illinois, then retired for a season or for some years, only to recur again. That is now impossible. I am confident in making this assertion, because it is inconceivable that anybody, official or otherwise, would be so negligent as to allow this invasion by disregarding the fact that yellow fever is carried from individual to individual by a certain mosquito. Yellow fever is now an unknown disease in this country. If you want to study yellow fever, you will have to go to Western Africa or to one or two places in South America.

When the United States went into Panama to dig the canal, it took hold of a job which France had had to give up because of her inability to control malaria and yellow fever. In the interval—the few years that had passed—came the new knowledge of these diseases, and our men went down to Panama and encountered relatively little malaria and no yellow fever. Actually not a single case of yellow fever has originated on the Isthmus of Panama since 1904, the first year of the work on the canal. This great service to humanity was the direct result of microscopic research, supplemented by experimental methods.

In speaking of carriers, I want to refer to one or two additional examples. Thirty-five years ago, an English scientist, Dutton, in west Africa, in conversation with a local doctor was told that the latter had found peculiar worm-like bodies in the blood of a river captain. The scientist promptly got hold of the captain, examined his blood and discovered a trypanosome, a flagellate protozoan. For a time that organism was supposed to be localized on the west coast of Africa, but within a year this same organism was found in Central Africa in cases of sleeping sickness. This was the African sleeping sickness, not the one commonly known to us. The cause of sleeping sickness was thus revealed and shortly thereafter came the further observation that the carrier of that disease was an insect, the tsetse fly. The microscope made it possible to follow that germ through the body of the fly, and the mystery of that disease was cleared up.

I will refer to another instance of this kind, and that concerns an insect which we ordinarily do not name in polite society, the body louse, which is capable of transmitting two diseases. One is relapsing fever (due to a spirochete) which at one time extended throughout Europe and at times was present even in the eastern United States. The other disease is typhus fever, where an exceedingly minute rod-shaped organism is present. Recognizing that this insect was the carrier of this disease, during the world war, special efforts were made on the western front against the importation of the disease by troops from Africa, and from the Orient. As a result not a single case of typhus fever developed on the western front, whereas on the eastern front, the disease became wide-spread. It has been estimated that thirty millions of cases of typhus fever occurred in Russia during and after the war. We can not conceive of those figures, but certainly western Europe and the United States have benefited by the use of the microscope in the study of this disease.

Time does not permit my taking up any more examples of this kind. In fact, I believe I have already gone beyond the limit set, but I want to leave with you this conclusion—that the microscope has enabled man to gain the mastery over his ancient enemies, the enemies that have afflicted the race from the beginning of time. If it accomplished nothing else, it would be a wonderful result, but it has done more. Optical studies in general have enlarged the boundaries of science in all directions.

And now, in closing, I wish to thank you again, my dear friends, Mr. Bausch, Mr. Eisenhart, ladies and gentlemen.

Frederick G. Novy

University of Michigan

OBITUARY

HENRY SEWALL

Henry Sewall, born at Winchester, Virginia, on May 25, 1855, physician and pioneer physiologist of America, passed on suddenly from a heart attack, in a measure as he would have chosen had it been in his power, on the morning of July 8, 1936, at Denver, as he was preparing for his breakfast with his wife, Isabel Josephine Vickers Sewall, who had been his close companion since their marriage in 1887.

Dr. Sewall at heart was always first a physiologist. He cherished the memories of his training under Professor Henry Newell Martin while teaching physiology in the newly founded Johns Hopkins University at Baltimore and following his graduation from Wesleyan University in 1876. He also cherished his associations with Carl Ludwig and Michael Foster during his European training. In 1881, he founded the new department of physiology at the University of Michigan, serving as professor and head under Dean Victor C. Vaughan, who later noted that "as a physiologist Sewall has had but few equals." At Ann Arbor, Sewall demonstrated that pigeons could be immunized to the venom of rattlesnakes,[1] an obser-

[1] Henry Sewall, *Jour. Physiol.*, 8: 203, 1887.

vation pointing the way to the discovery of diphtheria antitoxin, according to a delegation of Frenchmen who sought Sewall's laboratory at Michigan twenty years later.[2]

In 1888, Dr. Sewall received an honorary M.D. degree from the University of Michigan. Symptoms of pulmonary tuberculosis asserted themselves in 1885 and forced Sewall to leave Ann Arbor. During the winter of 1889, he became first resident physician, under the founder, Dr. Edward L. Trudeau, at the Adirondack Cottage Sanitarium, where Dr. and Mrs. Sewall occupied one of the first little one-room cottages. In 1890, Denver, Colorado, became his permanent residence, where he remained for the rest of his life. He brought honor to Colorado scientifically and became one of its most beloved physicians. He served as assistant health commissioner of Denver from 1891 to 1893, and secretary of the Colorado State Board of Health from 1893 to 1899.

When the National Board of Medical Examiners was established, he served this organization from 1915 to 1919. He received an M.D. degree from the University of Denver in 1889 and was professor of physiology in the Denver and Gross College of Medicine from 1890 to 1908. In 1912, the University of Michigan conferred on him the honorary Sc.D. degree, as did his Alma Mater, Wesleyan University, in 1926. From 1911 to 1918, Dr. Sewall occupied the chair of professor of medicine, at the University of Colorado School of Medicine, being emeritus professor since 1920. In 1916, he served as president of the American Association of Physicians; in 1924, president of the Colorado State Medical Society; and in 1927, president of the National Tuberculosis Association. In 1917, he became a member of the editorial staff of the *American Review of Tuberculosis,* the foremost tuberculosis journal in the world, a post he occupied from its inception on. In 1919, he became intimately associated with the research at the National Jewish Hospital at Denver, Colorado, serving as a member of the local and national advisory boards and as an active investigator also. His conscientiousness and industry are attested by a bibliography of over 123 original scientific articles, in later years devoted mainly to tuberculosis, climatology, immunity. In 1930, Dr. Sewall received the Trudeau Medal for his scientific investigations in tuberculosis, the first time this honor had been bestowed west of the Atlantic Seaboard states. In 1931, he was awarded the George Kober Medal of the Association of American Physicians. Dr. Sewall was a fellow of the American Association for the Advancement of Science since 1921, contributing to the success of sectional and association meetings.

Dr. Henry Sewall's life was dynamic and purposeful. He was beloved by patient and colleague alike. He was always welcome into that rare fellowship of those who understand. His intimate professional and scientific friends ranked from those crowned with success to those struggling for an education. He was a profound teacher whose lessons were never to be forgotten, founded as they were on scientific observations and knowledge. His demands for work were meager, content with a bench or room so long as his colleagues were there for communion. He didn't believe in retirement while there was work still to be done. In spite of his busy life, he always had time to aid charitable causes. Dr. Sewall's high place in the world of science and medicine will long remain vacant as a testimonial to the stature of him who last resided there.

H. J. CORPER

DENVER, COLO.

RECENT DEATHS

PROFESSOR FRIEDRICH BREINL, of the University of Praha, died on July 29 from an infection of Rocky Mountain fever. He was expecting to lecture on the subject before the International Bacteriological Congress in London. Professor Breinl taught bacteriology at Harvard University in 1925.

DR. AUBREY C. GRUBB, professor of physical chemistry at the University of Saskatchewan since 1921, known for his work on electrical activation of hydrogen and nitrogen gases, died on July 29.

SCIENTIFIC EVENTS

THE HIGH VOLTAGE LABORATORY OF THE UNIVERSITY OF LONDON

THE High Voltage Laboratory of Queen Mary College of the University of London was opened recently by the Earl of Athlone. The laboratory is the first in England to combine facilities for original research with facilities for training students.

The London *Times* writes:

Great Britain, in comparison with American and Continental Europe, has been ill equipped to provide the specialized training required for the study of problems in connection with the transmission of electrical energy at high voltages, and it is peculiarly fitting that the first great step in this country towards improving that position should be associated with Queen Mary College, where the high standard maintained by the electrical engineering department has led to its being entrusted with much

[2] Victor C. Vaughan, "A Doctor's Memories," p. 211. Publisher, Bobbs-Merrill Company. 1926.

of the research work undertaken by the British Committee of the International Electro-Technical Commission.

The new laboratory will have two main functions—to give instruction in existing knowledge concerning high voltage technology to engineering graduates, and to provide research facilities to extend existing knowledge on the same subject. In addition, the facilities of the laboratory will be available to research organizations for approved work, and it is hoped that advantage will be taken of this opportunity in the same way as the British Electrical and Allied Industries Research Association have utilized the resources of the college in the past.

The main laboratory has been constructed by removing from an existing building in the college a floor that divided it. Its main dimensions are 80 feet by 40 feet by 38 feet high, and the galleries of the original building now serve as excellent observation areas. In view of the layout of the laboratory, where five sources of very high voltage exist in various parts of the building, it has been necessary to provide a complete system of interlocked doors and screens so that, when once the occupants have vacated the danger area and the gates have been shut, no one can possibly enter it again without automatically cutting off the power. This has been achieved by means of electrical and mechanical interlocking devices arranged so as to permit the maximum use of each item of the equipment with the minimum of interference with the remainder of the laboratory.

Lectures on high voltage technology at the college will be supplemented by laboratory work.

FOUNDATION OF THE SMITHSONIAN INSTITUTION

August 10 is the ninetieth anniversary of the establishment of the Smithsonian Institution by Act of Congress on August 10, 1846, for "the increase and diffusion of knowledge among men."

"That date," says a statement issued from the Smithsonian Institution, "may be regarded as highly significant when considered from the viewpoint of nine decades later and of a world whose material life has been revolutionized by scientific research." The statement continues:

Few foresaw, even dimly, such an outcome in 1846. Pure science then was almost exclusively a hobby of individuals. Its pursuit was confined largely to gentlemen of means and leisure. In institutions of higher education it was far outranked by the so-called humanities.

Among those with at least a dim foreboding of the wonders ahead was an inconspicuous English scientist, who had died at Genoa in 1829. Before he died he concluded an act that was to immortalize him as one of the world's great benefactors of mankind. He incorporated in his will a clause leaving his entire fortune to the Government of the United States, in case his nephew died intestate, "to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men."

This gentleman was James Smithson, a natural son of the Duke of Northumberland. He was a student of chemistry and mineralogy whose early promise led to his election to the Royal Society of Great Britain shortly after his graduation from Oxford. The value of the estate that finally came to our National Government amounted to about $550,000. With this was set up by far the largest institution, up to that time, devoted to the pursuit of pure science without regard to immediate and obvious utility.

Thus was the support of science placed on a new basis. Endowed research institutions, some of much greater wealth, have sprung up over Europe and America since then, with the rapid realization that the shortest road to progress is the discovery of the basic laws of nature and that this can best be done by adequately supported, coordinated programs of research.

The terms of the Smithson will, in the opinion of Dr. Charles G. Abbot, secretary of the Smithsonian Institution, are ideal for such a purpose. So rapid is the progress of science that a problem that may seem of supreme importance to-day is outmoded to-morrow, and funds left for its pursuit exclusively become involved in serious complications. "For the increase and diffusion of knowledge among men" allows plenty of leeway, regardless of the developments of the future. The words will be as applicable a thousand years hence as to-day. Smithson's own words were indeed prophetic: "The best blood of England flows in my veins; on my father's side I am a Northumberland, on my mother's I am related to kings, but this avails me not. *My name shall live in the memory of man when the titles of the Northumberlands and the Percys are extinct and forgotten.*"

REGIONAL STATIONS OF THE U. S. DEPARTMENT OF AGRICULTURE

The Bankhead-Jones Act contains a provision for the establishment and operation of regional research laboratories by the Secretary of Agriculture. The *Experiment Station Record* reports that these laboratories are to be set up in the major agricultural regions, and under their jurisdiction research supplementing that otherwise provided for may be conducted "into laws and principles underlying basic problems of agriculture in its broadest aspects; research relating to the improvement of, the quality of, the development of new and improved methods of production of, distribution of and new and extended uses and markets for agricultural commodities and byproducts and manufactures thereof; and research relating to the conservation, development and use of land and water resources for agricultural purposes."

The act prescribes that half the special research fund which it allots to the department must be used for these regional laboratories. For the fiscal year which ended on June 30, the total fund was at least $392,000. The amount available for the regional laboratories was therefore approximately $196,000. For the following year, if the law remains unaltered, there will be $392,000; for 1938, $588,000; for 1939, $784,000 and for 1940 and each year thereafter $980,000. The maximum thus will be a sum appreciably higher than the $720,000 granted annually to the State Experiment Stations under the original Hatch Act.

No further restrictions are imposed by the act as to the number of regional laboratories, their location or the scope or details of their work. Three regional stations have been definitely provided for. These include a vegetable breeding laboratory near Charleston, S. C.; a cooperative soybean industrial research laboratory at Urbana, Ill.; and a grass-breeding and pasture laboratory at State College, Pa.

The vegetable breeding laboratory has for its purpose the breeding and introduction of high quality, disease-resistant vegetables especially adapted to the southern states, the states cooperating through an experiment station council. The experimental work is to be centered at the laboratory itself on a tract of about 450 acres acquired near the South Carolina Truck Experiment Station, but the materials produced there will also be tested in the cooperating states. The laboratory will be in charge of Dr. B. L. Wade, senior geneticist of the Bureau of Plant Industry.

For the Cooperative Soybean Industrial Research Laboratory the University of Illinois has made available laboratory space and other facilities. Dr. O. E. May, of the Bureau of Chemistry and Soils, has been appointed in charge of the laboratory, while the extensive breeding work contemplated will be under the direction of W. J. Morse, of the Bureau of Plant Industry. The research program is to be planned year by year by representatives of these bureaus and the twelve state experiment stations concerned and the director of the laboratory.

The grass breeding and pasture laboratory was established on recommendation of experiment station directors of the northeastern region. Facilities have been made available by the Pennsylvania Experiment Station, which has had under way pasture studies and other relevant work for several years. Among the objectives is the establishment of a nursery of all grasses and legumes adapted to the region and breeding experiments to develop new and better grasses. The leader of the general project is P. V. Cardon, in charge of the Division of Forage Crops and Diseases of the Bureau of Plant Industry.

THE CANCER INSTITUTE

THE first Cancer Institute will meet on September 7, 8 and 9 at the University of Wisconsin. Dr. William D. Stovall, director of the State Laboratory of Hygiene at the university, is chairman of the committee in charge.

Investigators from abroad who will speak at the general sessions and who will lead round table discussions include: Dr. Liev Kreyberg, of the University of Oslo; Professor Henry Coutard, chief of the department of x-ray therapy for cancer of the Radium Institute at the University of Paris, and Dr. Madge Thurlow Macklin, associate professor of histology and embryology at the University of Western Ontario.

Americans who are expected to present papers are: Dr. C. C. Little, director of the Roscoe B. Jackson Laboratory for Cancer Research at Bar Harbor, Me.; Dr. Edgar Allen, chairman of the department of anatomy of the Medical School of Yale University; Dr. H. B. Andervont, biologist of the U. S. Public Health Service at Boston, Mass. Dr. S. P. Reimann, pathologist and director of the Research Institute of the Lankenau Hospital and professor of experimental pathology in the Graduate School of the University of Pennsylvania; Dr. Emil Novak, associate gynecologist at the Johns Hopkins Medical School; Dr. J. B. Murphy, director of cancer research at the Rockefeller Institute for Medical Research; Dr. James Ewing, professor of oncology at the Cornell University Medical School, member of the staff of the Memorial Hospital for the treatment of cancer, New York; Dr. Gioacchino Failla, physicist at the Memorial Hospital, and Dr. Warren H. Lewis, of the department of embryology of the Carnegie Institution of Washington, at Baltimore.

The expenses of the conference are being defrayed by the Wisconsin Alumni Research Foundation.

INTERNATIONAL FORESTRY CONGRESSES

THE second International Forestry Congress will be held in Budapest from September 10 to 14. This will be preceded by a meeting and tour of the International Union of Forest Research Organizations from August 25 to September 8.

The first International Congress of Forestry, held in Rome in 1926, urged the holding of similar conferences periodically and entrusted the calling of such meetings to the International Institute of Agriculture. Through the request of the institute the Hungarian Government has called this meeting.

One of the main objectives of the conference is to bring about a proper balance between forest growth and timber consumption through the efforts of international cooperation. Discussion will center around

the economics of forestry, growth of forests and their utilization, timber trade and the influence of forests in regulating streams and controlling erosion.

Tours to the high-mountain country of Hungary and to afforestation projects in the plains have been arranged for September 15, 16 and 17.

The ninth Congress of the International Union of Forest Research Organizations will start on August 25 in Sopron, near Budapest, and end on September 8 in Lillafüred, after a tour of Hungarian forests, in ample time for the general congress in Budapest. The sessions of the research organizations will be held in Sopron. It is expected that questions of research technique, interchange of scientific publications and bibliographical information and research on forest influences will be discussed. Practically all nations in which forestry is important—including the United States—are represented in this union, which met from time to time before the war and was reorganized and enlarged in 1929.

Several American foresters, including F. A. Silcox, Raphael Zon, H. I. Baldwin, A. C. Ringland, John D. Guthrie, R. R. Fenska and Nelson C. Brown, will be in attendance at these meetings.

SCIENTIFIC NOTES AND NEWS

The National University of Ireland conferred the honorary degree of doctor of science on Dr. Simon Flexner, member emeritus of The Rockefeller Institute for Medical Research, New York, at University College, Dublin, on July 20.

At the annual degree ceremony held on June 29 the honorary degree of LL.D. was conferred by the University of Leeds on Dr. Henry Drysdale Dakin, F.R.S., of Scarborough, N. Y., editor of *The Journal of Biological Chemistry*.

Dr. R. A. Fisher, Galton professor of eugenics at the University of London, who is teaching at Iowa State College this summer, received the honorary degree of doctor of science at the commencement exercises of the summer quarter.

The doctorate of letters has been conferred by Brown University on Dr. Joseph L. Wheeler, librarian of the Enoch Pratt Free Library, Baltimore, Md.

The University of Glasgow has conferred the doctorate of laws on Alexander Lawson Mellanby, professor of civil and mechanical engineering at the Royal Technical College, Glasgow.

Nature reports that Dr. Albert Defant, professor of oceanography and geophysics at the University of Berlin, has been elected a foreign member of the Swedish Society of Anthropology and Geography, and has been awarded the Galathea Medal of the Royal Danish Geographical Society of Copenhagen.

Professor M. Askanazy, of Geneva, has been awarded the Marcel Benoit prize of 30,000 francs for his pathological researches on cancer.

In recognition of the services of Professor A. L. Bowley, who retires this year from the chair of statistics in the University of London, it is proposed to collect a fund for the painting of his portrait to be hung in the London School of Economics and to establish a scholarship or prize tenable in the School of Economics to assist a student pursuing undergraduate or postgraduate work in economic or social statistics.

Dr. George G. Heye, director, and the trustees of the Museum of the American Indian, Heye Foundation, New York City, have assumed financial sponsorship of the first publication, "History of Hawikuh, New Mexico" (ancient Zuñi pueblo), of the Frederick Webb Hodge Anniversary Publication Fund, commemorating Dr. Hodge's fifty years (1886–1936) in American anthropology. It will appear toward the close of the present year as a joint publication of the Museum of the American Indian and the Hodge Fund. The Hodge Fund, which now amounts to $3,000, will be a capital fund administered by the trustees of Southwest Museum, Los Angeles, of which Dr. Hodge is director. The income will be used for the publication of studies by anthropologists in the American field.

Dr. J. M. Rogoff has been appointed visiting professor of physiology at the University of Chicago. His research in endocrinology, with particular reference to the physiology of the adrenal glands in relation to diabetes and hypertension, is being supported by the G. N. Stewart Memorial Fund. This was created in honor of George Neil Stewart, one-time professor of physiology at the University of Chicago and later professor of experimental medicine at Western Reserve University, with whom Professor Rogoff collaborated for fifteen years at the latter institution.

In the College of Liberal Arts of Northwestern University promotions have been made as follows: Department of Chemistry, Dr. Frank T. Gucker and Dr. C. M. Suter to associate professorships; Department of Mathematics, Dr. Hubert S. Wall to an associate professorship and Dr. H. L. Garabedian to an assistant professorship; Department of Physics, Dr. Noel C. Jamison to an assistant professorship; Department of Zoology, J. W. Benjamin to an assistant professorship.

DR. RICHARD ROCKHILL VOGT, since 1916 a member of the faculty of the University of Notre Dame, will succeed the late Rev. Julius A. Nieuwland as director of organic research.

DR. WOLDEMAR WEYL, who for several years has been in charge of the division of glass research at the Kaiser-Wilhelm Institut für Silikatforschung in Berlin, has accepted a position as associate professor in the department of ceramics at the Pennsylvania State College. Dr. Weyl will arrive in America about the middle of the present month.

DR. JOHN SHAW DUNN, who at present holds the St. Mungo (Notman) chair of pathology in the University of Glasgow attached to the Royal Infirmary, has been transferred to the chair of pathology, vacant through the retirement of Sir Robert Muir.

THE council of the Royal Society, London, has appointed Dr. J. McMichael, of the Edinburgh Royal Infirmary, lecturer in human physiology in the University of Edinburgh, to be the first holder of the E. Alan Johnston and Lawrence research fellowship in medicine. He has been offered special facilities for his work at the Edinburgh Royal Infirmary. The value of the stipend is £700 per annum, plus superannuation allowance.

DR. W. R. TWEEDY, of the Loyola University School of Medicine, has received a grant from the Committee on Scientific Research of the American Medical Association to aid him in continuing his work on the physiological action of parathyroid hormones. Dr. Arthur Knudson, professor of biochemistry at Albany Medical College, has received a grant to aid his work on the study of factors responsible for the synthesis of cholesterol in the animal body.

PURSUANT to the policy of subsidizing research on the natural history of the Great Lakes region, the Board of Trustees of the Cranbrook Institute of Science has made grants for the fiscal year 1936–1937 for the following projects: Carl Hubbs and Reeve Bailey, "Biology of the Black Bass"; William Bay, "History of the River Valleys of Southern Michigan"; Marjorie Bingham, "Flora of Oakland County, Michigan," and "Natural Revegetation of a Gravel Pit"; Edward T. Boardman, "Comparative Behavior of Cercaria" and "Incidence of Parasitic Infestation of Small Mammals in Southern Michigan."

DR. NELSON W. TAYLOR, head of the department of ceramics at the Pennsylvania State College, attended the International Congress on Glass, held in London and Sheffield, as American delegate of the American Ceramic Society. Representatives of twenty-two different countries were in attendance.

DR. ANNA E. JENKINS, associate mycologist of the Bureau of Plant Industry, U. S. Department of Agriculture, has returned to Washington after a nine months' stay in Brazil, where she carried on investigations of certain citrus diseases in cooperation with Dr. A. A. Bitancourt, subdirector of the Instituto Biologico of São Paulo.

DR. D. E. HALEY, of the department of agricultural biochemistry at the Pennsylvania State College, has been called to Puerto Rico to assist the Puerto Rican Government in its new Tobacco Research Program. He will return to the Pennsylvania State College this month.

DR. FR. VERDOORN, editor of *Chronica Botanica*, honorary secretary of the botanical section of the International Union of Biological Sciences, is visiting the United States. He is working on American bryological herbaria under a fellowship of the Netherland-America Foundation.

SIR DAVID WILKIE, professor of surgery in the faculty of medicine, University of Edinburgh, will give a series of twenty-five lectures at the Jefferson Medical College of Philadelphia during next November and December.

POSTGRADUATE medical courses for practicing physicians will be given from September 14 to 18 by the Stanford University School of Medicine in cooperation with the San Francisco Department of Public Health and the San Francisco Hospital. In addition to nine regular courses conducted by specialists of different departments, there will be general meetings from eight to ten o'clock each evening. These are: X-ray Therapy, Dr. Robert Newell and staff; Backache, Drs. A. L. Bloomfield, D. E. King and L. A. Emge; Blood Diseases, Drs. H. P. Hill, H. A. Wyckoff and Garnett Cheney; Syphilis, Diagnostic Methods and Therapeutic Agents, Dr. C. W. Barnett.

AT the celebration of the centenary of Mark Hopkins as the fourth president of Williams College, which will be held from October 10 to 14, a program has been arranged devoted to the contribution of Williams College in the nineteenth century to the promotion of the natural sciences and the development of research. On the first evening Dr. C. A. Browne, '92, chief of chemical and technical research in the Bureau of Chemistry and Soils, U. S. Department of Agriculture, will speak on "Trends in Sciences during the Time of Mark Hopkins." Dr. W. Mansfield Clark, '07, De Lamar professor of physiological chemistry at the Johns Hopkins University, will be the chairman of a symposium at which the speakers will include: Dr. Irving Langmuir, of the General Electric Company, Schenectady, N. Y.; Dr. John Clarke Slater, professor of physics at the Massachusetts Institute of Technology, and Dr. Herbert Spencer Jennings, Henry

Walters professor of experimental zoology at the Johns Hopkins University.

The fourth International Congress of Pediatrics, which was to have been held this year in Rome, has been postponed until April, 1937.

The International Union of Geodesy and Geophysics meets this year in Edinburgh from September 17 to 26, and one of its constituent associations, that of hydrology, has a new subcommission named the International Commission of Snow, which then meets for the first time under the presidency of Professor J. E. Church, of the University of Nevada. The International Commission of Snow proposes to meet at Edinburgh on September 14 to 16 in advance of the meetings of the union. The program includes papers on "The Swiss Scheme of Avalanche Investigation," "Arctic and Antarctic Snow" and "Standards for Measuring the Precipitation of Snow."

According to the appraisal of the will of the late Edward J. King, of New York City, under which the Mount Sinai Hospital is subsidiary legatee, the hospital will receive the sum of $902,369.

Field Museum of Natural History has received from the National Museum of Prague, Czechoslovakia, a collection of 500 Mexican plants gathered in 1791 by Thaddaeus Haenke, botanist of the eighteenth century. Another historic plant collection has been received from the Botanic Garden of Madrid. This contains many valuable specimens collected in Mexico and South America about the year 1800 or earlier, by the Spanish botanists Ruiz, Pavon, Ortega, Lagasca and Cavanilles. These early collections from the former Spanish colonies are said not to be duplicated elsewhere in America.

The Soviet Government has decided to organize at Moscow a special institute for experimental physiology and therapeutics at the municipal hospital Pirogoff, in which physiologists, physical chemists, biochemists and other men of science will take part, and has allotted 500,000 roubles for its equipment.

The will of Miss Virginia Palmer, of New London, disposes of an estate said to be worth $4,000,000. The Connecticut College for Women and the Loomis School, of Windsor, Conn., each receive the sum of $500,000; the Lawrence and Memorial Associated Hospitals, New London, receive $400,000, and the Lyman Allyn Museum, $200,000. After providing for certain personal bequests and gifts to churches, the remaining estate is given in trust to the Hartford National Bank and Trust Company. The income will be paid to corporations, organizations, societies, institutions and trusts in the City of New London, which are devoted exclusively to religious, charitable, scientific, literary, historical and educational purposes. The trust is to be known as the Frank Loomis Palmer Fund.

The council of the Royal Society, London, has approved plans for medical research on malaria and on nutrition in India, involving a total expenditure of over £8,000 in the next five years. Colonel Sinton has been appointed to investigate certain aspects of malaria at the Horton Center. Another series of investigations on malaria, in conjunction with the London School of Hygiene and Tropical Medicine, provides for a study of mosquitoes in the Tropics. Dr. C. Wilson has been offered a research appointment to enable a survey of nutritional conditions in India to be undertaken.

Work on the new migratory bird refuge at the mouth of the Mississippi River in Plaquemines Parish, La., is to be started at once under the direction of the U. S. Biological Survey. President Roosevelt has approved a $600,000 allotment to the survey from the WPA appropriation. The greater part of this money will be spent in the Northwest, where the present drought is seriously threatening the nation's stock of wild duck and geese, and about $37,000 will be spent on the Delta refuge, acquired nine months ago.

Sir Joseph Ernest Petavel, director of the British National Physical Laboratory since 1919, who died on March 31, left an estate of the gross value of £61,161, with net personalty £43,023. He left his effects not otherwise disposed of to the Royal Society, desiring them to allow the director of the National Physical Laboratory to have the use and enjoyment of them so long as his residence shall be at Bush House. The residue of the property he left to the Royal Society absolutely, stating: "Whereas the National Physical Laboratory is called upon to take an important place in the national and international realm of science, and also it is undesirable that the possession of private means should be a consideration in the choice of a director thereof, and it is equally undesirable that the sphere of influence and usefulness of the institution should be restricted by lack of means for various purposes which can not appropriately be charged to public funds, he desired the Royal Society to apply the annual income from his estate as to two fifths to the director of the National Physical Laboratory for entertainment expenses, one fifth for the upkeep of his residence, one fifth for the maintenance of the gardens of the laboratory and of his residence and one fifth for other expenses in connection with the directorship of the National Physical Laboratory; this bequest is conditional on the present income of the director being in no way lessened."

DISCUSSION

EARLY OBSERVATION AND ATTEMPTED EXPLANATION OF THE GLACIAL DRIFT

ACCORDING to Merrill,[1] the "first recognition of or attempt to account for the glacial drift" was by Benjamin De Witt, who, in 1793, wrote a letter to the Philadelphia Academy, regarding a collection of sixty-four specimens (all different?) of stone found on the shore of Lake Ontario, saying "it is almost impossible to believe that so great a variety of stones should be formed in one place and of the same species of earth." His suggested explanations are an earthquake, or eruption, or that the lake was one of the fountains of the deep broken up when our earth was deluged with water. No more successful interpretation seems to have appeared until 1825 (Merrill, p. 273), when Peter Dobson, a cotton manufacturer, of Vernon, Conn., observed striated boulders and bed rock in the excavations for a new mill and inferred boulders held in grounding icebergs as the agency probably responsible for the phenomena.

But in 1816 (publication 1819) one David Thomas,[2] a farmer of Levanna, N. Y., and a student of botany and mathematics,[3] showed such discernment in observation of the depositional forms and composition of the drift that even though he was anticipated by DeWitt in recognizing the problem his contribution deserves recognition. Incidentally, Thomas's book made such an impression on DeWitt Clinton that he told a commissioner of the Erie Canal: "The man who wrote that book will make an excellent canal engineer." In consequence Thomas, though without training in engineering, was appointed chief of the exploring engineers of the Buffalo to Rochester Section (of the Erie Canal) and continued as chief engineer in that section until completion of the work.

Thomas and a companion left Levanna, near Auburn, N.Y., on May 21, 1815, on a journey to explore the "Wabash Lands" (Indiana) of the "New Purchase." They traveled north along the east shore of Cayuga Lake to its foot, then turned westward and, on the second day, nineteen miles from home, were approaching the north end of Seneca Lake. Here, after an introductory statement that "we eagerly contemplate traces of a period when matter was obedient to impulses that no longer exist," he begins his observations and comments on the drift by asserting:

At least two facts appear certain:— that the summits of our mountains have been swept by a *deluge*, and that much of the surface of the country owes its form to that extraordinary movement. . . . the greatest violence of that flood was exerted on the south shore of *Lake Ontario*. Hills of earth, pebbles and rounded stones were arranged by the same surges. . . . The parallelism of these ridges is nearly preserved and the average variation is about ten degrees to the left of the meridian. As this determines *the line of the current* it becomes an interesting enquiry to ascertain which way it flowed. Though the country declines to the north, it appears that this deluge had an opposite direction.

The principal facts that support this opinion are that detached parts of every rocky stratum which is uncovered, from the shore of Lake Ontario to the north bounds of Genoa, are scattered to the south of these ranges; and that seldom if ever have any such fragments been found to the north. [Thomas has all this in small caps.] An enumeration is subjoined [pp. 6–7].

He then lists specifically six different rock varieties that conform to his dictum.

In this one note Thomas recognizes: (a) that the form as well as the composition of the hills is a product of the deluge; (b) that the deluge went contrary to the slope of the land; (c) that drumlin hills have a parallel orientation; and (d) that no rock fragments appear to the north of their line of outcrop. On page 8 he records that *granite* and *gneiss* abound on the surface, which he says are admittedly foreign species, and he adds, "it is a curious fact that none are contained in the mountains to the south."

In a note, fourteen pages long, beginning at page 247, given the running head "The Deluge," Thomas continues his discussion of the drift deposits and struggles manfully to reconcile his observations with the action of a great flood. He is forced to admit that the form and composition of the drumlins are such that to ascribe their accumulation to water action is quite fatuous. He then considers the possibility of ice as the responsible agency, holds that ice could transport the rocks, but can not understand how it could bring about the singular depositions. He finally concludes that an attraction exterior to the earth impelled the floods uphill. He notes that Dr. Drake[4] asserts "fragments of primitive rocks are said to be scattered extensively over the state of Ohio, the Indiana Territory, and Kentucky." He himself saw granite near the Wabash and in Madison County (Ohio). With Drake he agrees that the granite came from Canada. He notes also that native rocks are deposited on heights far above the strata from which they were taken and, "worthy of remark," all such occur in greatest abundance immediately south of their native beds. The steep northern ends and other characteristics of the drumlins are described in detail.

[1] G. P. Merrill, Ann. Rept. of the Smithsonian Institution, U. S. Nat. Mus., 1904, p. 211.

[2] David Thomas, "Travels through the Western Country in the summer of 1816," Auburn, N. Y., 1819. (This book and its account of the drift were brought to the attention of the author of this note by Professor A. H. Wright, of Cornell University.)

[3] J. J. Thomas, Cayuga County (N. Y.) Historical Society Collections, No. 6, p. 39, 1888.

But striation of the bed-rock or the glacial scratches and polishing of erratics apparently did not attract his attention. In view of the acuteness of his observations of other phenomena this oversight is astonishing. It should be added that Thomas's notes on bed-rock geology are no less illuminating and discriminating than are those devoted to the drift. Thus in the Appalachian Plateau west of Pittsburgh he observes:

For mile after mile we saw strata . . . in both sides of these rounded hills at equal heights, we saw the same on the sides of the next hill, if equally elevated; but sometimes we passed a considerable distance over those which did not rise up to that level; and on ascending some which are higher, again the same strata appeared. . . . the idea is clearly presented that the vallies were cleared out after the strata had been formed by deposition. . . . These strata extended many miles, but at last disappeared, proving the notion of regular strata round the globe to be an erroneous extreme [pp. 76–77].

Thomas's time was one of much activity in geological science; his interest in such matters is therefore not difficult to understand. That, however, he saw so clearly and came so close to modern interpretations, not through random speculations, but from attempts, by long cogitation, to fit his observations to rational inferences, marks his work as deserving of a recognition it does not seem to have received.

O. D. VON ENGELN

CORNELL UNIVERSITY

TUMORS IN DROSOPHILA MELANOGASTER RESULTING FROM SOMATIC SEGREGATION

THE sex-linked gene, lethal-7, produces tumors in the male larvae at various stages of development. Tumor-bearing larvae do not survive to the adult stage and previously tumors of this origin have not been observed in the adults of either sex. To test the effect of this lethal-7 gene when exposed during development by the removal of its normal allele the following experiment was devised. Females carrying lethal-7 were crossed with buff, forked-5 males and the resulting females backcrossed to the same type of males. Forked females with red eyes from this backcrossing were mated to white-eyed, minute-w males. Nearly all the matings showed well-developed tumors in some of the larvae, and in every case half of the males failed to appear. Except for double crossing over, all the red-eyed, normal-bristled females were heterozygous for lethal-7, and such adults were examined for forked bristles and for tumors. Forked bristles appear as mosaics when the normal allele is removed from some of the cells either by deletion, non-disjunction or somatic crossing over.

In two cases forked bristles were found adjoining tumors. In one case a slightly depressed irregular area on the thorax showed small forked bristles on the margin. Underneath the epidermis in this depressed area there were several characteristic black tumors varying in size. The forked bristles were clearly bent at the tips. In the other case a peculiar outgrowth, somewhat resembling a balancer, grew out of the thorax near the base of the right wing. Both balancers were present and normal. This extra growth was accompanied by two large forked bristles near the base and on the outgrowth itself there were several dark-colored and thickened bristles. Apparently the normal allele of lethal-7 was also removed along with the gene for normal bristles.

Other offspring showed forked bristle mosaics without tumors, and tumors without any accompanying change in bristle formation. This is expected, since forked-5 is well removed from lethal-7. Somatic crossing over in Drosophila as shown by paired mosaics (twin spots) has been reported by several investigators. In this way as well as by deletion and other chromosomal irregularities, normal growth-regulating genes are removed from some cells during development in Drosophila as well as in maize and atypical growth results.

DONALD F. JONES

CALIFORNIA INSTITUTE OF TECHNOLOGY

RELATION OF ROOT PRESSURE TO PLANT DISEASE

A SATISFACTORY explanation for the occurrence of epidemics of many plant diseases is still lacking, despite a more clearly defined knowledge relative to the virulence of the pathogen, the inheritable susceptibility of the host and the relation of external environment. Evidence from many sources points toward factors making up the internal environment or "predisposition" of the host as being of fundamental significance. In this connection we wish to point out that the internal water relations of the host as determined by root-pressure may be an important determining factor in predisposition to infection and development of disease. The significance of this factor is naturally likely to be greatest with the less virulent parasites or the relatively more resistant hosts.

By means of the direct application of high-water pressure to the root system, high turgescence, guttation and water-soaking in various degrees may be readily induced for short periods with no permanent visible injury or wounding resulting. Tomato plants, for example, water-soaked in this manner are highly predisposed to infection with *Bacterium angulatum* Fromme and Murray, though they are difficult to in-

[4] Daniel Drake, "Picture of Cincinnati and the Miami Country," pp. 74–75, Cincinnati, 1815.

fect without water-soaking. Similarly, tobacco may be greatly predisposed to *B. angulatum* and *B. tabacum* Wolf and Foster, by the same method, resulting in large necrotic lesions comparable to those often noted under field conditions. Water-soaking as a consequence of water sprays or storm effects has recently been emphasized by Clayton,[1] and while the significance of this relation is not questioned, it lacks certain essentials as a satisfactory explanation in all cases of the epidemiology of the diseases in question. Infection through water-soaking by root pressure furthermore confirms Clayton's contention that the water-soaking is of greater consequence to infection than epidermal wounding.

Similar, though less striking, results have been secured through increasing root pressure by means of the simultaneous exposure of plants to a high soil temperature and a low air temperature, with the evaporation power of the air at a minimum. It should be emphasized that great differences between individual plants may exist with respect to the ease with which they become water-soaked, this being in part influenced by the ratio of the size of the root system to the leaves. High root pressures under field conditions, resulting from a particular sequence of weather conditions, are a fairly well-known phenomenon. That conditions of this type precede epidemics of disease in tobacco has been noted by the writer, whereas apparently more favorable external environmental conditions, including severe storms, in the presence of pathogens, have in many instances failed to result in expected epidemics of disease.

A more extensive account of the experiments bearing upon this problem will be presented later.

JAMES JOHNSON

WISCONSIN AGRICULTURAL EXPERIMENT STATION
BUREAU OF PLANT INDUSTRY
U. S. DEPARTMENT OF AGRICULTURE

A STUDY OF THE EFFECT OF DROUGHT ON TREES

THE 1936 drought is one of the most serious and widespread the nation has ever experienced. Not only have there been untold suffering by the local residents and terrific losses in crops, but other forms of life over considerable areas are showing the effects of abnormally high temperatures and deficient precipitation. Just how serious some of these effects are remains to be seen.

In forestry and plant ecology, droughts are of considerable significance because of their effects on survival, growth and behavior of trees and shrubs. Some species or individuals may be killed, others suffer severe injury, while still others may show remarkable ability to withstand the most adverse conditions. In times of severe drought, forest plantations suffer severely, especially those composed of species not native to the locality or those badly abused as by grazing. In addition many native species that have been slowly invading drier sites or localities may be eliminated over large areas.

As information on drought resistance of trees and shrubs is sadly lacking, the present affords an unusual opportunity to obtain data of outstanding value. Consequently, it is hoped that those who are in a position to do so will take notes on the reaction of various plants to the drought. Such information is not alone of scientific interest but has great practical value in many current operations, such as the reforestation program of the CCC, cultural operations in the forest, erosion and flood control, etc.

The Forest Service is undertaking the collection of data on the drought damage. In this it is seeking the aid of botanists, agronomists, foresters, meteorologists and other interested individuals throughout the drought area. Consequently, any one with observations on species behavior should communicate them to the Division of Silvics of the Forest Service at Washington, D. C. Data are desired especially on such features as the nature, extent and character of the damage, the relative resistance of trees growing on different sites, the comparative ability of native and exotic trees to withstand drought and the nature and extent of the damage to stands or to shade or ornamental trees, shrubs, etc. A questionnaire covering these points has been drawn up to aid observers in reporting the effects of the current drought.

E. N. MUNNS,
Chief

DIVISION OF SILVICS
U. S. FOREST SERVICE

REMARKABLE LIGHTNING BOLT

ON the evening of July 27, 1936, an exceptionally severe and spectacular electric storm passed over the Washington area, traveling very rapidly in a northwest-southeast course. The center of the storm kept somewhat west of the writer's position at Clarendon, Virginia, and at a point in the southwest, only a few miles away, there appeared a most spectacular frequency of discharges earthward. Some appeared as mere single sparks, but the majority were of the repeating or of the stream type of discharge of exceptional size, appearing like ribbons of flame searing the darkness.

One of these, which seemed almost to hang in the sky only a few miles away, appeared to ignite something high in its course, leaving wisps of flame which per-

[1] E. E. Clayton, *Jour. Agr. Research*, 52: 239–269, 1936.

sisted momentarily, detaching themselves from the stream and drifting eastward from the path of the discharge as if carried by the wind. This phenomenon was observed at several points along the discharge, and was also witnessed by my son, Howard F. Allard, who was observing the lightning beside me. A portion of the path of the discharge, at and below these points, was also indicated by a train of sparks persisting momentarily after the streak had gone. Although I have made it a special point to observe the electrical displays of storms since a child, this phenomenon has never presented itself to me before.

H. A. Allard

Washington, D. C.

SCIENTIFIC BOOKS

MAN AND HIS ENVIRONMENT

Deserts on the March. By Paul B. Sears. University of Oklahoma Press. 1935, $2.50.

In the small compass of 231 pages of easy reading, Professor Sears gives an integrated picture of the relation of man to his environment as seen through the eye of a trained ecologist and publicist, who brings science, experience and history to bear on the interpretation of this relationship. He pictures the continents before disturbed by man, and then step by step through the centuries with population increase, land cultivation, destruction of natural forest or plant cover, bringing on erosion by wind and water, dust storms and floods with destruction of life and property.

Against a background of what has taken place in China, India and Egypt, he presents the picture of the course of events in the North American Continent due to the destruction of our forests, the wasting of our soils, the destruction of the food resources of our streams, lakes and oceans. Looking at these events from the view-point of the naturalist, he views man and his affairs not only as causes, but as reacted upon for good or ill by the changes he brings about. A wealth of scientific fact is presented as an aid in understanding the deeper causes and meaning of the intricate phenomena involved in man's relation to nature. Technical language is avoided.

The book will be of intense interest to men of affairs everywhere, as well as to scientists. The citizens of the world must enlarge their thinking to rightly understand their relation to the environment in which they live and upon which their welfare and that of future generations depends. This book will help greatly to that end.

The writer is an ecologist in the broader use of that term. In his own words the book, speaking broadly, is "an attempt to interpret the relations and adjustments of man as they appear to the ecologist, with due regard for the many intangibles which enter the human setting. If these chapters have told their story the importance of ecology to plant and animal industry and to any program of land utilization, should be obvious." I may add that the social value of such training is also obvious.

A. F. Woods

CYRUS GUERNSEY PRINGLE

Life and Work of Cyrus Guernsey Pringle. By Helen Burns Davis. Burlington, Vermont. Paper, 756 pp., 2 portr. For sale at the Pringle Herbarium, Williams Science Hall, University of Vermont; price $1.50. 1936.

This book is a useful and appropriate memorial to a great botanical explorer. The title may be somewhat misleading; the work is not at all the usual biography. It is, indeed, prefaced by a brief account of Pringle's life; but the bulk of it consists of transcripts from his diaries, comprising every passage relating to his travels and his collecting in Mexico from 1885 to 1909, and of two lists of his collections, one arranged systematically and one by numbers, both giving determinations of his specimens and recording their presence or absence in the herbaria which contain the first three sets—his own at the University of Vermont, the Gray Herbarium and the United States National Herbarium. In addition, there is a partial bibliography of his published writings, reprints of some of them from "Garden and Forest" and indices of persons and places mentioned and of plant names.

Pringle ranks among the foremost botanical collectors. A man of singular uprightness and conscientiousness, he spared no effort toward the perfecting of his work, and in his many journeys to Mexico acquired a knowledge of its flora which enabled him to collect with unusual intelligence. His sets were not only of high technical quality, they were actually of selected material, containing a large proportion of novelties and species otherwise of particular interest. They found a ready market; they are represented in nearly all the great herbaria of the world. They have, in consequence, great reference value in addition to their intrinsic scientific worth; they are classic in their field. Therefore a book like this, which enables one readily to place any given number and to obtain the complete itineraries and other collateral information often much to be desired in regard to any collection so important, is very welcome to the taxonomist. The compiler has done her work faithfully and well. One feels that Pringle himself, who earnestly desired to be serviceable to science, would have chosen just this useful sort of memorial.

Scarcely less welcome are the glimpses of Pringle's highly individual personality and the sidelights on his methods of work which the diaries afford. One can only regret that his early journeys to the Pacific states in 1880–1884 and the brief visits to Cuba in his last active years could not have been included.

C. A. Weatherby

Gray Herbarium, Harvard University

SPECIAL ARTICLES

SURVIVAL OF ASCARIS EGGS AFTER CENTRIFUGING[1]

Fertilized eggs of *Ascaris suum* in the uncleaved stage, in the 2-cell stage and in the 4-cell stage of development were exposed to a centrifugal force of approximately 400,000 times the force of gravity for one hour in the ultracentrifuge recently developed by J. W. Beams. The eggs were then removed from the rotor, placed in depression slides and their stratification and stage of development noted and charted by aid of the microscope. They were found stratified into 3 distinct layers: (1) a layer of yolk at the centrifugal pole; (2) a middle clear and apparently homogenous protoplasmic layer; and (3) a layer of fat at the centripetal pole. In some cases the fatty layer was observed to be separated from the rest of the egg.

Twelve hours after the eggs had been centrifuged it was observed that they had lost their stratified condition and some of them had undergone mitosis. After 48 hours at least 90 per cent. of them had divided once. They were observed at intervals under the microscope until they had developed beyond the 8-cell stage, which extended over a period of approximately 3 or 4 days.

In a second set of experiments eggs in the same stages of development as those used in the first were exposed to a centrifugal force of approximately 150,000 times the force of gravity for $4\frac{1}{2}$ days. They were studied in the same manner as those mentioned above. Here also, at least 90 per cent. of the eggs were observed to be alive and to develop at about the same rate as the controls. In still other cases, eggs have undergone cleavage while rotating at 100,000 times gravity.

These results seem to bear directly upon the questions recently discussed by Taylor[2] concerning living and non-living colloidal systems. He states:

> If, therefore, a centrifugal force applied to the ground substance (protoplasm) were sufficiently great, it, too, would suffer a stratification of its colloidal components no less definite than that of its grosser, visible inclusions as effected by ordinary centrifuging. Indeed, in recent times many non-living colloidal systems have been successfully stratified by means of the ultracentrifuge as perfected and employed by Svedberg (1928) and others. But to what extent the living ground substance would endure the rigors of such enormous forces (10,000–100,000 times gravity) and remain living, is, of course, exceedingly problematical. If the basis of protoplasmic organization is molecular—a postulate which now applies to colloidal systems generally—we may reasonably suppose that the living substance physically owes its being to the condition and maintenance of its unique structure. This qualification of the spatial relation of its component parts, once violated by mechanical or other forces sufficient to disrupt that spatial relationship, is thereby relinquished and the living substance disintegrates and dies.

It is of interest to note here that according to Bodine and Boell[3] practically no change in the oxygen consumption of blocked grasshopper eggs occurs after centrifuging at 400,000 times gravity, although such eggs do not recover. We have shown that the protoplasm of Ascaris eggs in the early stages still remains living after being exposed to forces equal to the maximum employed by Svedberg to separate from solution many artificial colloids and native colloids, such as proteins. However, we have been unable to determine whether or not a stratification of the protoplasmic components under such strong centrifugal force has taken place. If such does take place, it is of particular interest, for then the normal spatial relationship of the separate elements can not be of vital importance for the maintenance of life. However, if, as we are inclined to believe, little or no separation or stratification of the components has taken place in this material, they must be held together in a firmer way than those in the colloidal systems examined by Svedberg. In other words, the conditions present in this living colloidal system (protoplasm) seem to be different from those in non-living ones.

We are of the opinion that the killing of cells by the present methods of centrifugation is usually due to mechanical distortion or disruption (prevented in Ascaris eggs by the presence of a very resistant shell) rather than to a disturbance of the spatial relationship of their molecular parts.

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[1] Aided by grant from the Rockefeller Foundation for Research in cellular biology.

[2] C. V. Taylor, *Physiol. Zool.*, 4: 423, 1931.

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THE SEMIQUINONE OF THE FLAVINE DYES, INCLUDING VITAMIN B_2

Since it has been shown that many derivatives of phenazine, such as pyocyanine,[1] α-oxyphenazine[1] and

[1] L. Michaelis, *Chem. Reviews*, 16: 243, 1935.

chlororaphine,[2] form a semiquinone radical as an intermediate state of reduction, it was suggestive to search for such a reaction in the closely related group of dyes consisting of the derivatives of isoalloxazine, including what is called lactoflavin, the dye-stuff component of Warburg's yellow respiration enzyme,[3] and identified with vitamin B_2 by Kuhn.[4] In fact, Kuhn and Wagner-Jauregg[5] showed that in a very acid solution an intermediate red form of the dye can be observed. At pH >1 no trace of this red form could be found.

Now, in the case of pyocyanine it has been shown[6] by a potentiometric method that even around neutrality a definite although small amount of the semiquinone can exist in equilibrium with the oxidized and the reduced form. Accordingly, Kuhn and Moruzzi,[7] Stern[8] and later Stare[9] have attempted to show that the same holds for the flavines. They applied the potentiometric method, basing calculations on what has been called the index potential.[10] Stern especially made much use of this method. In a paper to be published soon it will be shown that qualitatively the results of these authors are acceptable, those obtained by Stern even more so than those obtained by Stare, but quantitatively they have to be subjected to considerable improvement before they finally lead to a clear picture of the situation. However, even this evidence is based on very delicate observations of the index potentials in that range of its value where an error of a few tenths of a millivolt makes a big difference in the equilibrium percentage of semiquinone. Under these circumstances it is desirable to have supplementary even though only qualitative evidence for the existence of the semiquinone in neutral solutions. The following experiment gives satisfactory evidence.

A solution of any representative of the flavines (including vitamin B_2), saturated at 70°–80° C., in a buffer anywhere between pH = 4 and 10, and always kept about this temperature to avoid precipitation, is mixed with a suitable amount of solid sodium hydrosulfite. The color changes from intensely yellow through a dirty olive green to pale yellow, and on reoxidation by air the whole color change is reversed. The color of the semiquinone in approximately neutral solution is, therefore, green. In very acid solution it is red. This is due to a different state of ionization, there being a dissociation constant of the semiquinone, pK = 1.0, approximately. In the very low concentration obtainable at room temperature in weakly acid or neutral solution it is more difficult to observe this phenomenon, although it can be observed on looking through the whole length of a test-tube.

The existence of this intermediate form in neutral solution, which previously rested on rather tenuous evidence, has now been made much more certain by this color reaction. It is easy to imagine that this property, in general very rare in dye-stuffs and just encountered in a group of dyes, one of which has such an important physiological property, if it contains a side chain of a definite steric structure (d-Ribose), should be of physiological significance. It is suggestive to think that in some cases the active form of certain enzymes might be the semiquinoid form. Here, a definite level of *oxidation-reduction,* observed in only a few dyes, is the active form, in analogy to the fact that in some other enzymes one definite state of *ionization,* as determined by the pH, is the kinetically active form.

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[3] W. Warburg and W. Christian, *Biochem. Zeits.*, 266: 377, 1933.
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[5] R. Kuhn and T. Wagner-Jauregg, *Ber.*, 67B: 361, 1934.
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[8] K. G. Stern, *Biochem. Jour.*, 28: 949, 1934.
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[10] L. Michaelis, *Jour. Biol. Chem.*, 96: 703, 1932.

ELECTRICAL BRAIN WAVES AND TEMPERATURE

In a previous note in this journal,[1] I reported that values of the critical thermal increment of approximately 8, 11 and 16 thousand calories had been found for the frequencies of the alpha rhythm (most commonly called the "Berger rhythm" by Adrian and others) in a group of 6 patients whose temperatures were elevated by diathermy. Recently Jasper[2] has criticized the identification of these values, since he finds fluctuations of several cycles per second in a run of an hour or two without, he says, any temperature change.

Fig. 1 is a plot according to the Arrhenius equation of frequencies (F) of the alpha cycles as a function of absolute temperatures (T). If the equation fits, one should get a straight line of negative slope by plotting log F against $1/T$. μ in calories is determined directly from the slope of the line. All the data involved in my first report are embodied in this figure as well as data from 4 additional subjects—10 in all. The lower curve of the figure ($\mu = 8000$ calories) corresponds to 7 daily experiments on 3 normals, 8 daily experiments on 2 mild general paretics and 5

[1] H. Hoagland, Science, 83: 84–85, 1936.
[2] H. H. Jasper, Science, 83: 259–260, 1936.

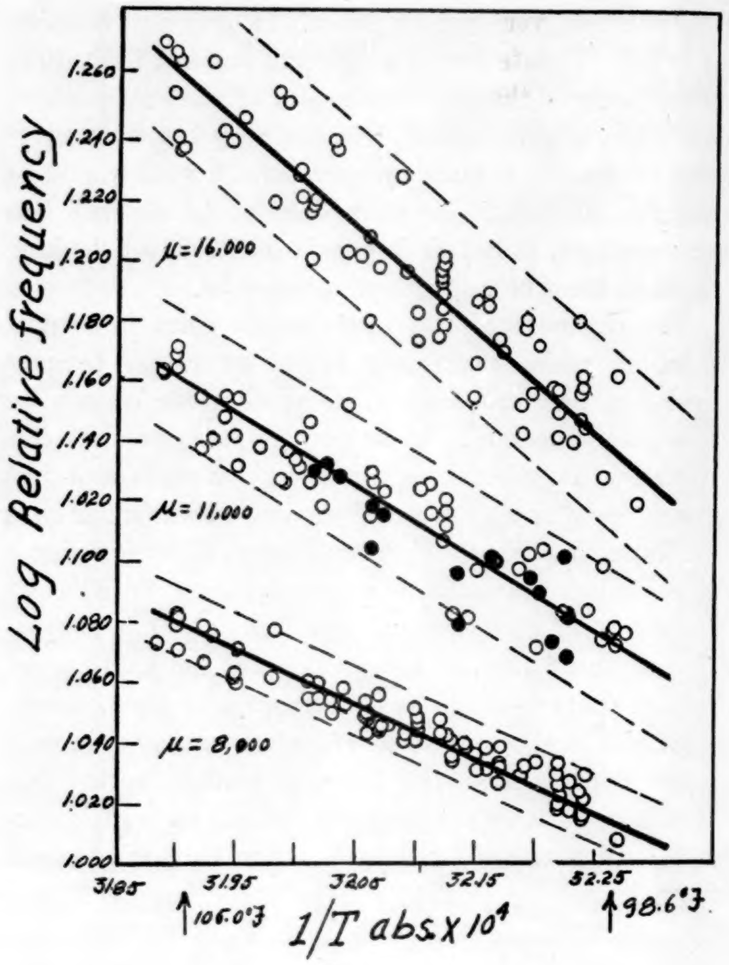

FIG. 1.

experiments (each a week apart) on a multiple sclerosis out-patient. Each experiment involves from 5 to 9 points; approximately 500 alpha waves are averaged for each point in Fig. 1.

The relative *variability* is shown by the vertical height of the band between the two parallel broken lines on either side of the heavy mean line. The $\mu = 11{,}000$ band corresponds likewise to 11 experiments on 2 general paretics who have had the disease longer than those of the 8,000 group. The $\mu = 16{,}000$ band corresponds to 14 experiments on the 2 other general paretics. One of these was decidedly the most advanced case of the group. The clinical record of the other, while showing an advanced stage, was incomplete and did not permit one to say that the paresis was more advanced than in the 11,000 group. The clinical records were independently analyzed by Dr. F. H. Sleeper. Of course, many more cases are necessary before clinical generalizations can be made. Some 115,000 alpha rhythms have gone into the determinations. Individual experiments are brought together in the band of appropriate slope by multiplying ordinates by a suitable constant. The ordinate intercept of each group is, therefore, arbitrary. The slopes alone are here significant. The 15 solid black points of the $\mu = 11{,}000$ curve show frequencies as a function of *descending* temperatures in 4 experiments. No hysteresis effect is seen, thus indicating the quantitative *specificity* of the temperature effect and showing that any small downward drift in frequency which may occur in time at normal body temperature is quantitatively overcome when the underlying mechanisms are driven by elevated temperatures. The slight decline in frequency after 1 to 2 hours recorded by Loomis, Harvey and Hobart[3] may possibly be due to a corresponding fall in temperature as basal metabolic conditions are approached.

There is no question of the independence of the three μ values as evidenced by the three distinct slopes of the lines. It is interesting that the variability represented by the width of the parallel bands apparently increases with the advancement of general paresis. The banded form of the variability means that the relative (per cent.) variability is constant over the temperature range for each graph. The variability is, of course, organic and far exceeds errors of measurements and is of the type commonly found in studies of physiological rates as a function of temperature. The specific factors making for excessive variability listed by Jasper were avoided to a great extent in the series. The *reversible* fit of the Arrhenius equation, the specific μ's which correspond to numerous determinations for O_2 consumption and CO_2 production in cells and the measured variability thus obviate the criticisms. In addition, Jasper's findings do in fact support our own. His values of 7,000-8,000 calories for normals and petit mals agree well with ours for the normals, the multiple sclerosis patient and the two least affected general paretics. The higher values of 11,000 and 16,000 appear to be products of the advancement of the infection which might quite reasonably be expected to shift the pacemaker, *i.e.*, the slowest process in the sequence of cortical cell respiratory events determining the relaxation oscillation frequencies. Work with poikilothermous organisms has repeatedly shown similar shifts due to chemical manipulation from one of these three values to another (Crozier and Stier).[4] Jasper agrees with me in favoring the idea of a relaxation oscillator mechanism for the brain waves, but for different reasons. It would indeed be surprising, granting such a mechanism, if the Arrhenius equation did not fit the data.

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PYRUVIC ACID IN URINE AFTER HARD EXERCISE

DURING nine experiments in which athletic young men ran quickly to exhaustion on a treadmill, we col-

[3] A. L. Loomis, E. N. Harvey, G. Hobart, SCIENCE, 8 239–241, 1936.

[4] W. J. Crozier and T. J. B. Stier, *Jour. Gen. Physiol.*, 9: 547–559, 1926.

lected urine from the subjects before and after the run. The nitroprusside test for pyruvic acid[1] was negative for the urine passed before exercise, but was positive for that passed after exercise. We collected urine also from eight boys after they had run the ¼ mile or the ½ mile race in a track meet. In seven cases the test was positive.

Pyruvic acid 2:4-dinitrophenylhydrazone was prepared from the boys' urine by the method used for pigeons' blood by Johnson.[2] The melting point was 214° (uncorr.) and the mixed melting point with synthetic pyruvic acid 2:4-dinitrophenylhydrazone was 213° (uncorr.). Therefore the substance giving the positive nitroprusside test in the fresh urine was probably pyruvic acid.

In one experiment a subject ran on a treadmill to complete exhaustion in 1.70 minutes at 11.2 m.p.h. Urine was collected before and 50 minutes after the run and blood was drawn from the antecubital vein before and 5 minutes after the run. Analyses for pyruvic acid were made by Peters and Thompson's[3] modification of the Neuberg-Case method. The results are shown in Table I.

TABLE I

PYRUVIC ACID (MG. PER 100 CC)

	Before run	After run
Blood	<1	3.37
Urine	0	5.80

Methylglyoxal also can be detected by the use of 2:4-dinitrophenylhydrazine, but we have not seen methylglyoxal 2:4-dinitrophenylosazone in any of our experiments. Therefore, pyruvic acid but not methylglyoxal seems to be one of the variable constituents of blood and urine during hard exercise. These results are interesting because of the contention by the schools of Embden and Meyerhof that pyruvic acid is of considerably greater significance than methylglyoxal in muscular metabolism.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A PRACTICAL METHOD FOR INDUCING OVIPOSITION IN DIURNAL LEPIDOPTERA

IT has long been the general impression that living butterfly eggs were difficult to obtain. During the summer of 1932, while attempting to obtain numbers of larvae for experimental purposes, the writer succeeded in finding a satisfactory method for inducing oviposition in all the species tried.

Gravid females ready to deposit eggs were obtained in the field. These could be detected by their tendency to hover about the food plant, or by their leisurely flight and inclination to pause near leaves rather than on flowers. The wings of these insects were clipped to within a fraction of an inch of the body in order to prevent fluttering, which usually resulted in rapid exhaustion. A small amount of food plant was next placed in a curved-neck bottle filled with water, and the tips of the stems were cut off under water. The leaves of the plant were placed so that they were in contact with the bottom of an ordinary Mason jar lying on its side (Fig. 1). The jar was then oriented so that the bottom or closed end was nearest to the source of light, which was a large window. After the butterfly was released in the jar, the open end was closed with netting.

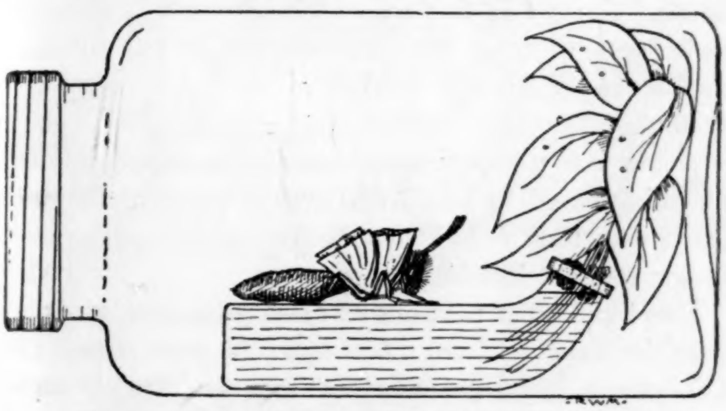

FIG. 1. Butterfly ovipositing jar. Light enters from the right.

In such close confinement with the food plant the butterfly invariably would become active, walking first in the direction of the light, up over the food plant and back again. Many individuals would deposit an egg on the plant at each trip until all the eggs were laid. Once a day the insects were removed and fed on sugar water, the fore tarsi being immersed in the solution to insure prompt feeding.

The following species were tried and all oviposited readily: *Papilio ajax* L. (=*asterias* Cram.); *Pieris protodice* Bdv. and Lec., *Pieris rapae* L.; *Colias eurytheme* Bdv.; *Vanessa atalanta* L.; *Vanessa cardui* L.; *Basilarchia arthemis* (Drury), and *Basilarchia archippus* (Cramer). When confined without food plant, a specimen of Harris' Checker-spot, *Melitaea harrisi* (Scudder), laid a single mass of more than two

[1] L. J. Simon and L. Piaux, *Bull. Soc. Chim. Biol.*, 6: 477, 1924.

[2] R. E. Johnson, *Biochem. Jour.*, 30: 31, 1926.

[3] R. A. Peters and R. H. S. Thompson, *Biochem. Jour.*, 28: 916, 1934.

hundred eggs on a bit of cheese-cloth. In the case of *Papilio ajax,* a breeding cage was employed and a sprig of wild parsnip was placed in its best lighted corner. The result was excellent.

In order to rear larvae, the bits of leaves with attached eggs were placed on fresh food plant in tin cans covered with pieces of glass. The plant in this case was also kept in a curved-necked bottle. This type of tight container retained the moisture, which is absolutely essential for small larvae. However, they were soon transferred to large breeding cages.

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PREPARATION OF NON-TOXIC URINE FRACTIONS FOR ASSAY OF MALE HORMONE BY THE FEMALE BITTERLING TEST[1]

IN testing urines for hormones by means of the female bitterling (*Rhodeus amarus*)[2,3,4] it was found that certain urines were toxic to the fish. Sometimes the addition of as little as 45 cc of untreated urine to 4 liters of water proved fatal to the fish within 24 hours. Since this test will probably be widely used as a means of assay for male hormone, it was deemed important to attempt to remove the toxic factor or factors.

After many experiments the simple expedient of dialysis proved to be all that was necessary. It had previously been found that the ovipositor-lengthening factor was not lost in dialysis.

Two hundred cc portions of fresh urine with specific gravities ranging from 1.018 to 1.036 were placed in Cellophane bags and dialyzed against running tap water for 24 hours. The specific gravities then were 1.001 to 1.003. The urines were then boiled to destroy bacteria. Amounts equivalent to 150 cc of the original urine to four liters of water containing two bitterlings were not in the least toxic to the fish. Since employing routine dialysis we have had no deaths of the fish due to the toxicity of urines.

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[1] Aided by a grant from the Lucius N. Littauer Foundation.
[2] Kleiner, Weisman and Barowsky, *Jour. Amer. Med. Assoc.*, 104: 1318, 1935.
[3] Kleiner, Weisman and Mishkind, *Jour. Amer. Med. Assoc.*, 106: 1643, 1936.
[4] Kleiner, Weisman and Mishkind, *Proc. Soc. Exper. Biol. and Med.*, 34: 367, 1936.

AN ELECTRICALLY HEATED NEEDLE FOR PARAFFIN EMBEDDING

THE use of needles periodically heated in a gas flame for orientating small material during the process of embedding in paraffin has several disadvantages. The constant reheating involves loss of time, and there is danger of damaging fine material, such as root tips, with needles that are too hot. The device described here has been in almost daily use in this laboratory for the past four months and can be easily made at a trifling cost.

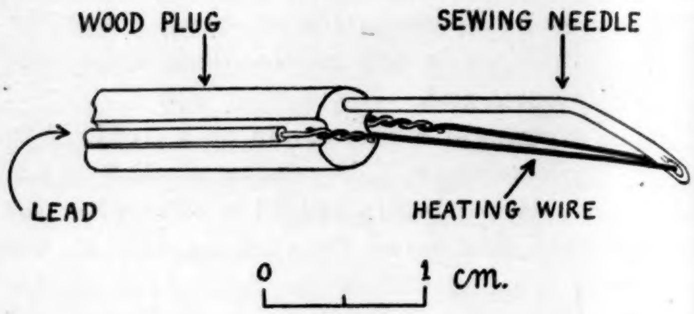

FIG. 1

The drawing shows the method of construction. It will be seen that a loop of heating wire is passed through the eye of a bent sewing needle, the needle being fixed into a small wooden plug. This plug, which has grooves cut in it to receive the leads, can either be long enough to serve as a handle or else it can be fitted into the end of a thin bamboo cane. In the former case it can be bound round with insulating tape to hold the leads; these are best made of light electric bell flex. The heating wire, 4 cm long, is of 40 S. W. G. nickel chromium, having a resistance of about 60 ohms per meter. It is best, but not absolutely necessary, to silversolder the wire to the leads. The current is supplied from the mains through a small transformer giving 3.3 volts, so that about one ampere flows through the heating wire. It is of course easy to adjust the length and gauge of the resistance wire to suit any small transformer that is available.

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